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ELWYN DEWDNEY

Dating Rock Art in the Canadian Shield Region

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ART AND ARCHAEOLOGY

ROYAL ONTARIO MUSEUM

SELWYN DEWDNEY

Dating Rock Art in the Canadian Shield Region

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Dating Rock Art in the Canadian Shield Region

Introduction

A systematic search for aboriginal rock art in the Canadian Shield Woodlands initiated by the Royal Ontario Museum in 1957 with financial support from the Quetico Foundation, and subsequently supported by the Glenbow Foundation and the National Museum of Man, has resulted in the deposition in Toronto, Calgary and Ottawa of basic illustrated records of over 200 Shield sites scattered across four Canadian provinces and one American state. While this work was in progress other investigators became involved, as early as 1965, and by 1969 at least another 50 sites had been added to the total – by Pohorecky and Jones in Saskatchewan, Steinbring, Elias and Whelan in Manitoba, and by Kenneth E. Kidd and the Vastokases in Ontario. By the fall of 1967 it was possible to define the distribution of these sites throughout the region that lies between the northern limit of the paper birch and the southern edge of the Shield from as far northwest as the waters draining into the Slave River to as far east as the St. Maurice River in Quebec (Figure 1, pages 8–9).

The great majority of some 300 known occurrences of rock art in the Shield Woodlands are rock paintings, or petrographs, painted on vertical rock faces that are situated without exception on shore outcrops facing the water. A mere 20 sites are petroglyphs, all but two of which are incised on the surface of relatively horizontal rock beds. Lacking colour, seldom deeply carved, and frequently in the bush interior, they are extremely difficult to find; and I estimate that only half the actual total have been located. Earth and boulder effigies are not included in this study and a serious dating investigation of the glyphs must await the discovery of a larger number of sites. This paper, therefore, is primarily concerned with the rock paintings.

Since 1967, although an estimated 75 to 100 minor rock painting sites still await basic recording, the attention of investigators has turned increasingly towards attempts to solve the formidable dating problem. In the pages that follow I propose to explore the complexities involved in finding a solution, pursuing the following sequence:

1. Description of a concentration of rock paintings in northern Saskatchewan, and of preliminary efforts to determine and measure at this site those features that might enable one to distinguish paintings of earlier origin from those executed more recently.
2. Survey of techniques used elsewhere in the world to determine the age of rock art, discussion of their possible application to the Shield paintings, and emphasis on the need for a new approach.
3. Assessment of the possibilities of an approach based on intensive study of the variables involved in promoting or inhibiting the physical

impairment of the paint and rock substrate, with a description of field studies made to explore these possibilities at selected sites in Manitoba and Ontario.

4. Discussion of preliminary results, and an outline of the three-pronged attack on the dating problem that seems to offer the best hope of a solution.

Definition of Terms

Garrick Mallery made it clear in his preliminary publication, *Pictographs of the North American Indians* (1886; 58–65), that he regarded "pictograph" as the generic term for *all* forms of aboriginal "picture-writing." He defined three broad groups on the basis of the surface used: natural surfaces other than human, human (painted and tattooed), and artificial surfaces. Rock art was included in the first category as "rock carvings" and "coloured rock-pictures." In his final work, however, (1894; 1–800) he referred to pictographs on rock surfaces, whether carved or painted, as "petroglyphs."

It is perhaps too late to reach an agreement on what labels should be used for what categories of pictography, especially for international use. For example, in French a common term for rock art is *art rupestre*; in German, *felszeichnungen*, in Russian, *naskalnye izobrazheniya*. In fact the only term that seems to have penetrated linguistic barriers in the Western world is "petroglyph" for rock carvings.

At the first meeting of the Canadian Rock Art Research Associates held at Lakehead University in December, 1969, terminology was discussed in some detail. A consensus was reached on the broad categories; but it was also agreed that the more specialized terms involved semantic complications that were next to impossible to sort out. The conclusion was that it would suffice for any investigator to define such special terms as he might feel it necessary to use. Of the following definitions, those agreed upon by the conference are capitalized; the others are not.

PICTOGRAPH: the generic term: any example of the two-dimensional art of a preliterate culture that is assumed to have a communicative (as distinct from a purely decorative) intent, whether at supernatural, shamanistic, or secular levels.

Perishable pictography: all pictographs stamped, stencilled, embroidered, engraved, scraped, painted or otherwise rendered: on bark, hide, wood or comparably perishable surfaces (hence "hide pictography," "birch-bark pictography," etc.).

Durable pictography: all pictographs scratched, scraped, pecked, carved, painted, sprayed or engraved on bone, shell, ivory, ceramic, stone or other durable surfaces. Paintings or engravings on cave walls in Europe are known as "parietal art." The term "art mobilier" refers to three-dimensional art as well as to durable pictography, whether or not it is thought to have a communicative intent.

ROCK ART is now the widely accepted English term in North America for all durable pictography rendered on rock surfaces, or formed out of rock (as in boulder effigies or mosaics).

PETROGLYPH refers to rock art executed by cutting or breaking *through* the rock surface. A convenient, unambiguous term is "glyph." I use the word *glyphstone* to refer to prairie "ribstones" and other small, carved boulders.

ROCK PAINTING is preferable to *petrography*, which may be confused with "petrology," a geological specialty. "Rock drawing" could refer to a thinly engraved petroglyph. Essentially a rock painting is distinct from a glyph in that it is rendered *on the surface* of a rock face, without breaking it.

Figure is the term I prefer for a single pictographic unit, capitalizing it to avoid confusion with "figure" as designating a human figure. Other terms occurring in the literature are "design element," "motif," "character," "ideograph" and "pictorial unit." All, including "Figure," fall short of clear specificity.

Face, like "figure," must be capitalized to distinguish it from its common meaning. I use the term to refer to a single Figure, or a group of Figures, on a common rock plane. Where such a plane is of substantial dimensions and the Figures tend to form separate groupings, I refer to the groupings as *sub-Faces*. A group of identical markings that presumably signifies a numeral I regard as a single Figure.

SITE, while accepted as the term for the place where rock art is found, tends to be variously defined. Obviously, if two groups of pictographs occur on the same shore outcrop half a mile apart we may speak of two sites. At the other extreme lies the instance of two Faces, quite clearly produced by different hands and apparently at different times, separated by only a few feet of rock surface. Should each be designated a separate site? In the urgency of time usual to the conditions under which I did my basic recording I evaded such questions. Rock art occurrences out of sight of each other I usually designated as separate sites, unless they were merely around the corner of the same rock formation. When in doubt I have used the term "sub-site."

Setting is another rather vague word. In my usage, whereas a site is the geographical position of the rock art occurrence, related to the larger features of the local landscape, the setting (like the setting of a gem) refers to the immediate surroundings of a given Face, especially those features that affect its exposure to the weather.

Canadian Shield Woodlands. "Canadian Shield" is now the recognized geographical term for the region in North America where glacial action has exposed Pre-Cambrian bed rock in a broad horseshoe circling Hudson Bay and extending into the Arctic Islands. The former term "Laurentian" is now confined to Shield formations north of the St. Lawrence River and Gulf. Approximately half of the Canadian Shield on either side of Hudson Bay extends beyond the treeline. "Canadian Shield Woodlands," therefore, is a useful term to distinguish between the wooded and treeless regions of the Shield. Ethnographically the term is particularly apt because it defines a region where natural waterways abound and the bark of the paper birch is available, so determining that the birchbark canoe would become the preferred means of warm weather travel and transportation by the indigenous people – predominantly, from contact times, of Algonkian stock.

The Hickson-Maribelli Rock Paintings

One of the major concentrations of aboriginal rock paintings occurs in northern Saskatchewan, on the Narrows between Hickson and Maribelli Lakes, 63 air miles due north of Stanley Mission (see map, Figure 1). Indeed it is rivalled in the number of Faces and Figures by only one Shield site, at Bon Echo on Lake Mazinaw in southeastern Ontario, some 1,400 miles distant. At Bon Echo there are 28 designated Faces and 153 Figures: the Hickson-Maribelli site has as many Faces but only two-thirds as many Figures. On the other hand, where many of the Bon Echo paintings have been weathered to the point of obscurity, those in the Saskatchewan site remain relatively intact. One must avoid conclusions as to comparative age on this basis, however, if only because weathering proceeds more slowly in northern latitudes and the Saskatchewan site is a full 11 degrees farther north. Latitude is only one of many factors – as we shall see – that are involved in the rate at which paint is impaired at a rock painting site.

The map provided includes only the central and western regions of the Shield Woodlands. In the eastern region, from Lakes Superior and Huron to the Gulf of St. Lawrence, only 27 sites have so far been located, and not for lack of looking. East of the Ottawa River only a single site has been found to date, on Lac Wapizagonke, a source of the St. Maurice River (Dewdney, 1969; 32–5). Intensive lumbering operations in the Ottawa valley as early as 1850 involved the building of numerous dams to facilitate the flow of square timbers. These early operations and subsequent hydro-electric projects throughout the whole region between Georgian Bay and the St. Maurice River have undoubtedly flooded an indeterminate number of sites, so that it is impossible to give a reliable distribution picture for the eastern region. Fortunately in the central and western regions, although some 30 sites are known to have been flooded out, their location has been recorded and the distribution map provided is reasonably complete.

Pictographically, these regions can be divided into two zones: a southern and a northern. A majority of the rock paintings are concentrated in the southern zone. This lies between Lakes Superior and Winnipeg, and coincides with the known occurrence of wild rice in the region. Climatically less rigorous than the northern zone, it has always – presumably – supported a larger population. The boundary between the two zones is shown with a broken line in Figure 1. In the northern zone the climate, flora and fauna are clearly sub-Arctic. Here the rock painting sites are scattered more thinly, although some concentrations still occur. Only three sites have been found within 100 miles of the northern limit of the paper birch: on the Severn River in Ontario, at Egenolf Lake in Manitoba, and on a small lake southeast of Great Slave Lake in the Northwest Territories.

Due to disturbance of earlier patterns of human occupation by the fur trade, and the innumerable obstacles to archaeological exploration presented by so vast and thinly populated a region, our knowledge of the distribution of aboriginal populations is minimal. Historically the Athapaskan-speaking Chipewyan are known to have hunted as far south as the Churchill River in Saskatchewan and Manitoba. A majority of the rock paintings found in Saskatchewan occur along, or close to, the Churchill. Yet the two major sites, at Larocque Lake (Dewdney, 1963; 6) and the Hickson-Maribelli Narrows, lie well within traditional Chipewyan territory. On the other hand Cree middlemen are known to have ranged freely from early fur trade times as far northeast as Churchill, and northwestward to Great Slave Lake (Innis, 1962; 202–3).

There are three sites on or near Hickson Lake. A faint, vestigial animal form found during my first visit is on the lake itself. Two weeks later,

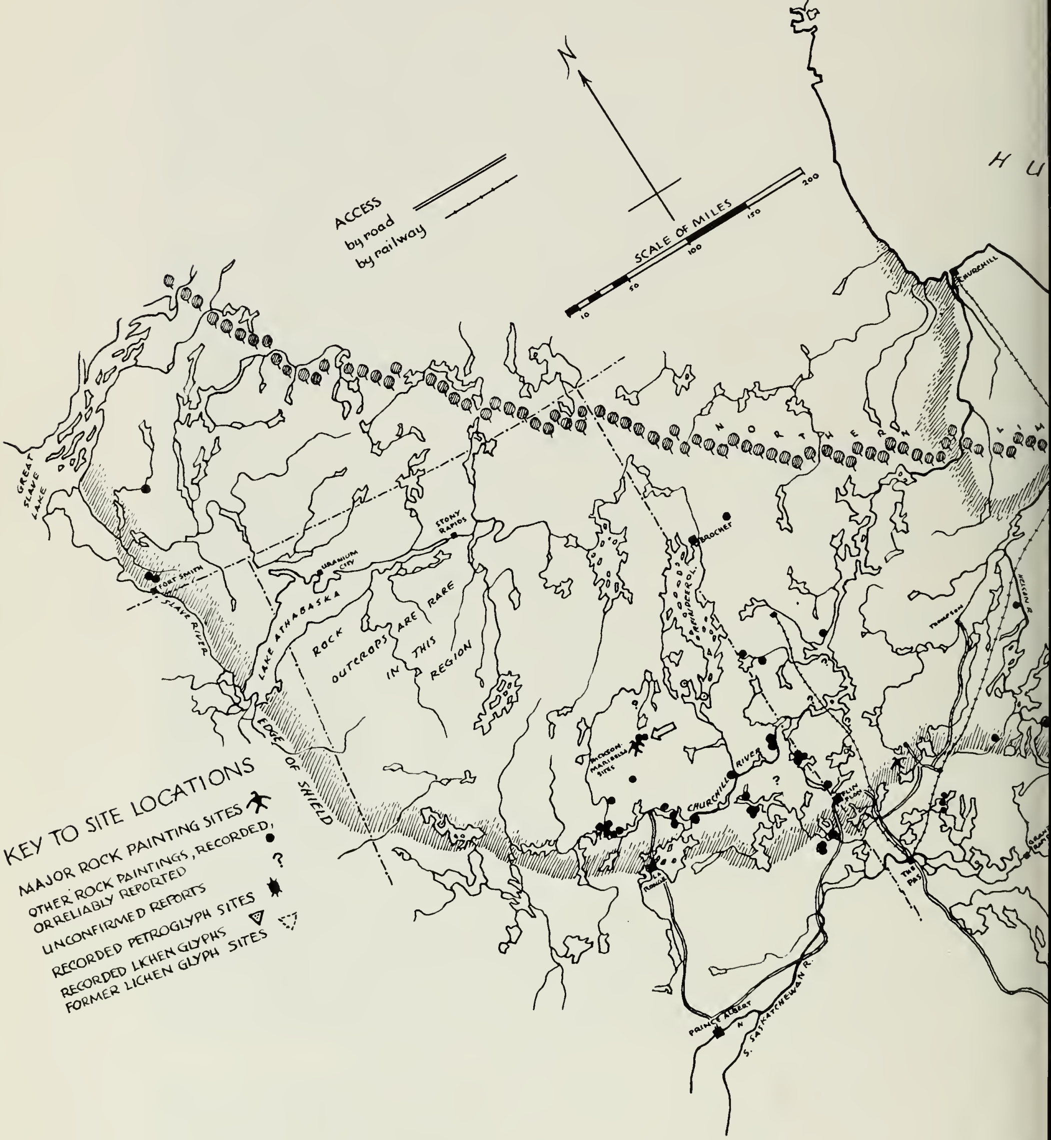
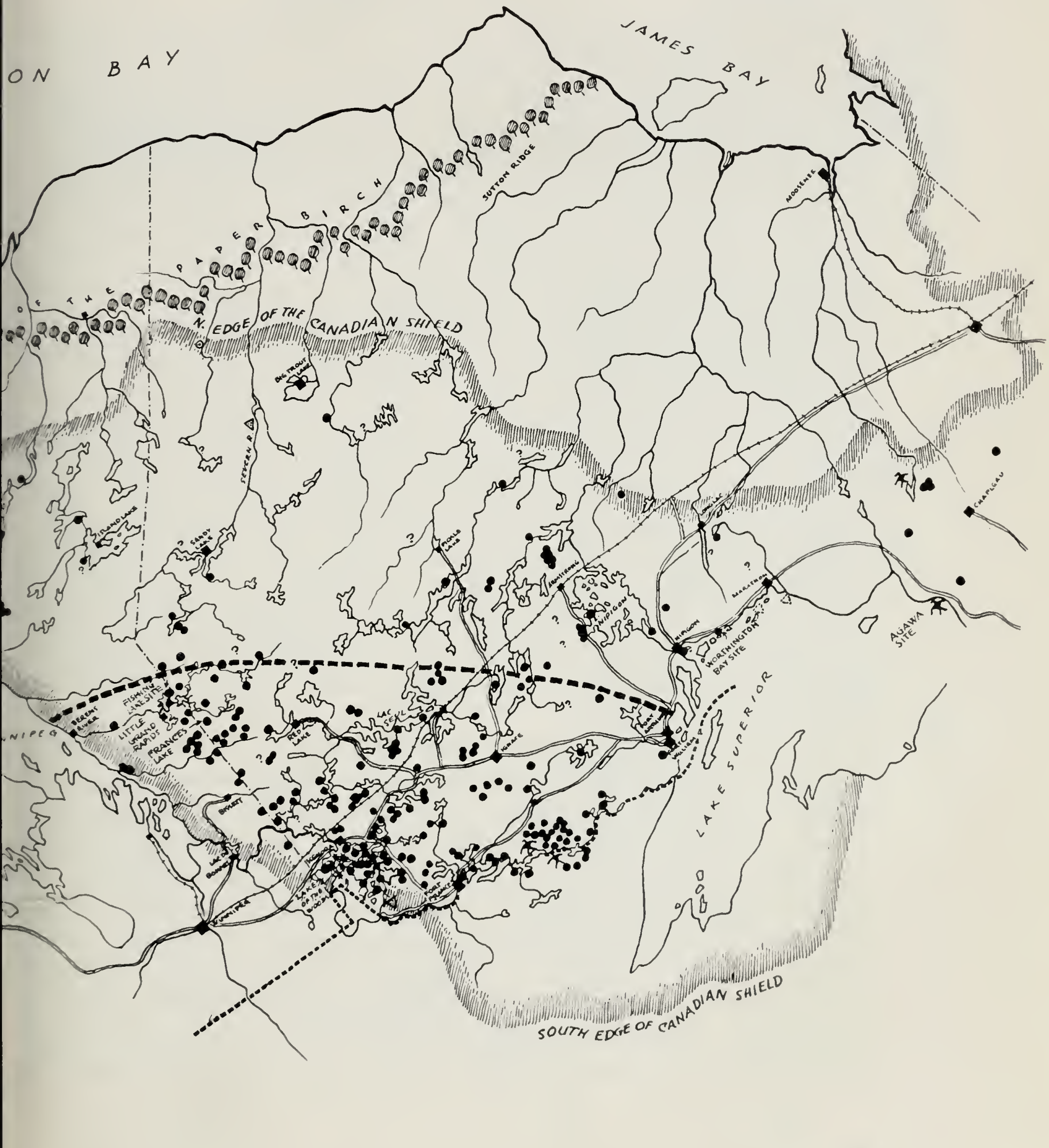


Fig. 1 Distribution of aboriginal rock art sites in the central and western regions of the Canadian Shield Woodlands.

returning with more detailed information, I was able to locate two sites in the Narrows, a two-mile-long channel that leads from Hickson to Maribelli Lake. The main site, designated #181 in my personal site inventory, is almost exactly halfway along the channel. A second much smaller group of paintings, #182, with three Faces and a dozen Figures, is on the arm of Hickson Lake that leads into the Narrows. The description that follows is confined to the main site.

Figure 2 illustrates the dimensions and character of the rock formation where the paintings are situated, reproduces the paintings themselves, and



charts their distribution along the base of the formation. A selection of these paintings will be reproduced on a more adequate scale with the text that follows. A map inset locates the two sites on the Narrows.

The main site includes 28 Faces, including five sub-Faces. Variations in style and paint quality indicate the work of a number of different hands. Some paintings – judged solely by the apparent degree of weather impairment – seem to be considerably older than others. All but seven Faces were placed close enough to the prevailing summer water level to have been painted from a canoe. Of the exceptions four could only have been made from convenient rock ledges; the others would have been accessible during high water. Each Face is easily accessible from the water; none from the shore. All the paintings were made with variations of red ochre (impure anhydrous iron oxide) or a paint producing the colour effects typical of red ochre.

My chief informant about the site was a middle-aged Cree at Otter Lake by the name of Roberts. According to him Site #181 lies on the main canoe route from the Churchill River over the height of land into the Reindeer Lake drainage by way of the Pink and Wathaman rivers. In 1965 I investigated reports of two sites farther north along this route, but neither location looked promising, and if the reports were accurate my failure to find them could only be accounted for by the high water that prevailed that summer. This once well-travelled route is now so little used by Cree or Chipewyan that of a dozen wide-ranging Cree I interviewed at La Ronge and Otter Lake only Roberts was aware of, let alone able to locate, the sites in the Hickson-Maribelli Narrows. As chief guide for the fly-in tourist fishing camp on Hickson Lake he knew them well. He stated that his father had first seen the paintings in 1901, but had known nothing of their age or significance. This area, although traditionally in Chipewyan territory, was undoubtedly travelled by Cree middlemen and beaver hunters from an early period of the fur trade. An air view of the site is shown in Plate 1.

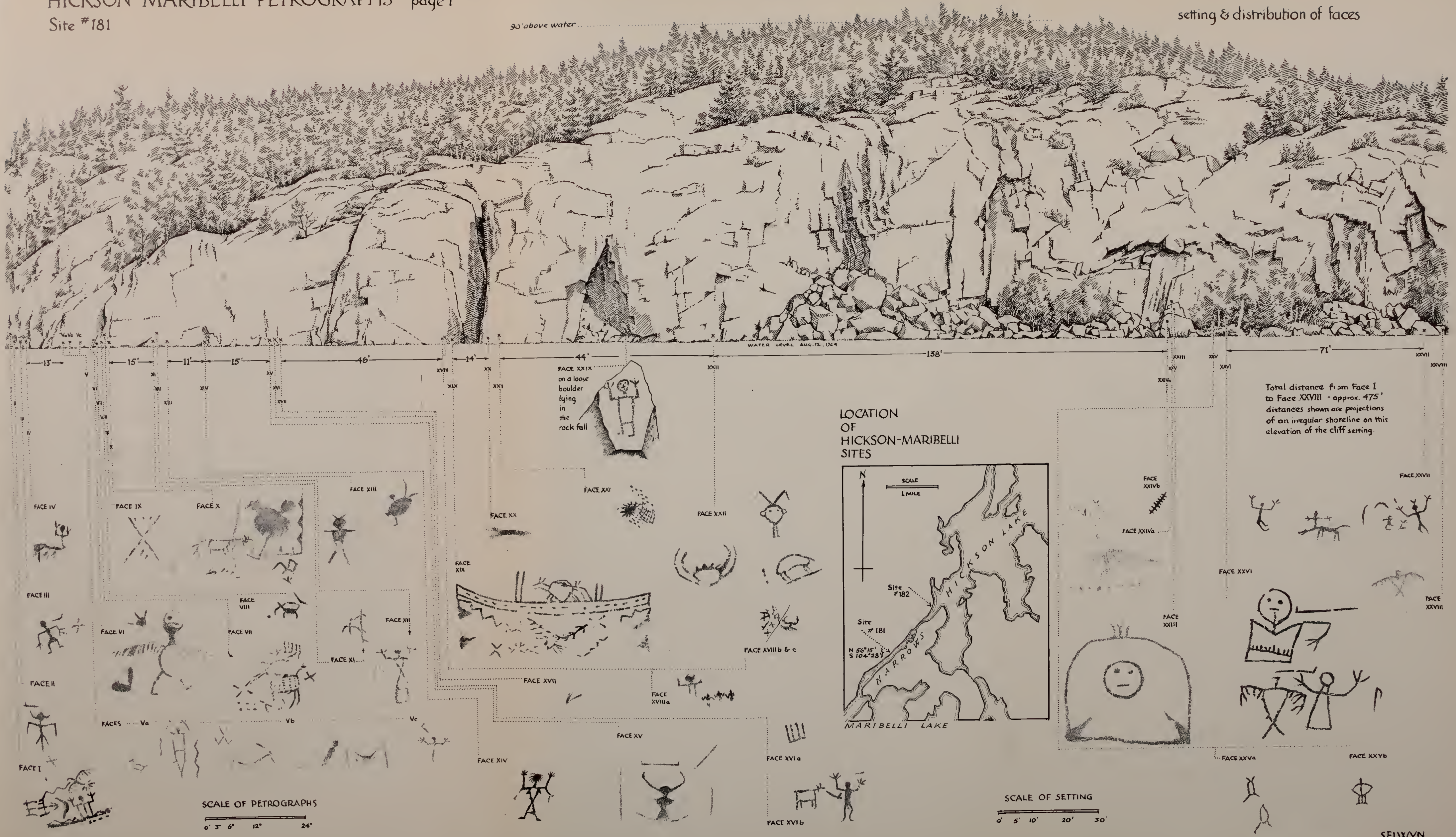
The food resources are currently substantial, and – apart from periodic epidemics or fires – presumably always have been. It is good moose and beaver country, and still supports a number of woodland caribou. Lake-trout fishing is excellent. In spite of the probability that it supported a prehistoric population, the archaeological evidence of this has not yet been searched for seriously.

Few rock art occurrences in the Shield Woodlands are associated with so impressive a setting. The Narrows themselves seldom exceed 100 yards in width, with generally steep sides. There is only one adequate camp site, a small, gravel-built island half a mile east of the paintings that is poor by comparison with a number of excellent sites on the adjacent lakes. The mass of granitic rock where the paintings occur rises some 90 feet above the water and extends 400 feet along the shore. A deep, high fissure, clearly shown on Figure 2, provides the illusion of an entrance into the rock wall, and does in fact penetrate it enough to hide a small canoe. No visitor can linger in the vicinity without some feelings of awe, for, though the dimensions of this rock would seem slight to a person accustomed to mountainous

HICKSON-MARIBELLI PETROGRAPHS page 1

Site #181

setting & distribution of faces



Total distance from Face I to Face XXVIII - approx. 475' distances shown are projections of an irregular shoreline on this elevation of the cliff setting.

ALL REPRODUCTIONS OF PAINTINGS ON THIS SHEET ARE DRAWN TO THE SAME SCALE

DISTANCES SHOWN ALONG THE BASE OF THE CLIFF ARE APPROXIMATE ONLY

SELWYN DEWDNEY /64

terrain, their scale in relation to that of rock outcrops usual in the Shield country is massive.

On my first of three visits to this site my informant had given me no indication of the unusual number of paintings involved, and the time I had allowed for drop-off and pickup by the provincial aircraft allowed basic recordings to be made of barely half the Faces. The following year, 1964, I camped overnight, with nearly two full days to work at the site, during which I had time to complete the basic records and make extensive notes.

Meanwhile I had become more and more dissatisfied with the limitations of my recording techniques. A reasonable efficiency had been developed at obtaining all the information needed for making reproductions at the desk suitable for museum deposition. Tracings, colour photographs, sketches, and measurements taken at the site ensured that the paintings themselves and their relative disposition along the rock face and in relation to the water level were all accurately duplicated. Such surface features as lichen growth, cracks, fissures and other gross irregularities were also recorded. In addition, when time allowed I made notes and sketches of the features that promoted or inhibited moisture access and exposure to sunlight, and took rock samples.

Yet, early in the work it had become apparent that no easy estimate of the age of a painting could be made on the basis of the apparent strength of the pigment, or on the impairment by weathering that seemed to have taken place; nor was there any precise way of measuring the effects of either. Obviously some paintings were better protected than others, and pigments varied widely. Nevertheless it seemed reasonable that if a thorough assessment were made of all the major factors involved in the impact of weather on the paintings, at least a rough scheme could be devised that would make it possible to distinguish between paintings that were of relatively early origin and those that had been painted far more recently.

In 1965, armed with a list of the features that theoretically promised to separate older paintings from more recent ones, and with C. Dewdney as a student assistant, I returned to the Hickson-Maribelli site. Records were made for each of the Faces and sub-Faces (33 in all) at the site. Table 1 summarizes our findings for six of these Faces, selected as being most representative of Shield sites in general.

It had been my hope that, by assembling such data, and assigning to each item an arbitrary numerical value based on my assessment as to whether the factor involved would promote or inhibit the weathering of the paint, a significant total would emerge for each Face that at the very least would isolate the paintings of recent and early origin from each other in terms of *probabilities*. The weaknesses of this approach will become apparent later; but it will be useful at this point to follow the reasoning employed in the choice of data to be recorded, in order to illustrate the complexities involved.

Under *orientation*, I argued that the compass bearing of the rock face, together with its vertical angle, would determine the duration and intensity of exposure to sunlight. "Plus" readings signified that the rock sloped out

Table 1

WEATHER EXPOSURE AND RESISTANCE FEATURES OF PAINTED ROCK FACES AT SITE #181

Feature Observed	Face I	Face V	Face VI	Face VII	Face X	Face XXVI
Orientation of Face						
a. compass bearing*	105°	180°	267°	216°	190°	45°
b. angle to vertical	11° plus	6° plus	26° minus	0°	3° minus	0°
Protection						
a. from descending drip and seepage	small overhang and cracks 2 ft. above	10 ft. up to nearest rain-catching shelf	nil	slight	overhangs & cracks divert seepage	nil paintings on boulder
b. from ascending splash & flooding	above flooding & splash level	fully exposed to both	partially exposed	fully exposed to both	fully exposed to both	only 3 ft. above water
Nature of rock surface						
a. kind of rock	granite	granite	granitic	granite	granite	granite
b. texture	medium rough	slightly glaciated	medium rough	slightly glaciated	vestigial glaciation	rough
c. surface "flaws" or interruptions	major crack	exfoliation and cracks	major crack through head	numerous cracks	major cracks & exfoliation	nil
d. patination	some, to left	moderate	slight	patchy	faint	nil
Encroachment						
a. by lichen	nil	nil	one third of surface	2 small thalluses	nil	nil
b. by lime deposits	thin film	nil	nil	nil	nil	nil
Colour						
a. typical red ochre	yes	yes	dull brown	yes	yes	yes
b. "wetness" of colour	wet	dryish	wet	dryish	dryish	dry
c. pigment intensity	strong to weak	medium to weak	medium to weak	strong to nil	strong to weak	very weak
Paint Impairment						
a. by exfoliation	nil	some	one small area	granular exf.	extensive	granular
b. by frost cracking	some	some	some	extensive	impairment	
c. other	nil	ice erosion	bullet mark	ice erosion	nil	nil

*Direction of exposure, uncorrected for magnetic declination over the water, reducing direct sunlight but offering more protection from rainfall; "minus" readings indicated the opposite. *Protection* referred to features that inhibited the moisture supply: overhangs or cracks that diverted seepage and drip from above; and height above the water or ledges that reduced wave splash from below. The *nature of the rock surface* affected its vulnerability to the weather. Thus a granite would be more resistant than a chlorite schist; and a rough, porous rock face would yield more readily to the elements than a smooth, compact one. Surface flaws would offer leverage for frost action, and patination would offer clues as to how long a given Face had been exposed since it split off from the mother rock. Plate 2 illustrates how variable the settings of four adjacent Faces may be.

Encroachment by lichens should logically hasten the weathering process; while its mere presence would indicate the availability of moisture. Where an overlay of lime, or other mineral deposit, was present the surface was offered some protection.

Under *colour* I recorded the quality of the red ochre, assuming that with acculturation in the historical period the artist would be satisfied with inferior pigments. The distinction between "wet" and "dry" pigment comes from the observation that in some paintings only the rock pinnacles are coated, whereas in others the paint floods the valleys between. I recorded these aspects in the hope that they might prove to correlate with other data. Pigment intensity related the strength of the colour to the full strength of such artist's earth colours as Indian Red or Burnt Sienna, as an assessment of the "fading" undergone by the original colour.

Paint impairment was intended to describe any damage done to the paint by the weathering of the rock substrate, evidence visible to the naked eye that the rock itself had yielded to spalling or frost action even though the paint that adhered to it had not lost its bond.

In retrospect I became convinced that the last two categories were too subjective to be valid. For example a paint passage that seemed to have faded might in fact merely be the result of applying an originally weak pigment. Examination of various samples of red ochre from grave goods in the archaeological collections of the Royal Ontario Museum convinced me that there have always been wide variations in the strength and purity of the pigment. As for evidence of paint impairment due to the weathering of the rock subtrate, it was quite conceivable that a fresh painting might have been made on a surface that was already severely weakened by weathering.

In total the results of this preliminary attempt were discouraging. Much more had been learned about the complexity of the factors that contributed to the protection or the impairment of the painted surfaces. But this very complexity, added to the difficulty of measuring the variables objectively and the final problem of achieving some kind of correlation that would have some significance as a dating device, made the whole approach seem impracticable. Certainly, before I pursued it any further, it would be wise to search for a simpler and more direct approach, by surveying methods of dating rock art that had been successful in other parts of the world.

Review of Rock Art Dating Techniques, and their Application to Shield Problems

Dating approaches used elsewhere may be grouped under eight headings, according to the evidence on which they are based:

1. stratigraphic evidence
2. superpository evidence
3. style analysis (typology)
4. laboratory techniques
5. weathering action
6. lichenometry
7. ethno-historical evidence
8. prehistoric clues

STRATIGRAPHIC EVIDENCE

In the Franco-Cantabrian region of southwest Europe the most reliable method for estimating the age of prehistoric art found in caves and *abris* (rock shelters) has been stratigraphic. In some instances minimal dates were arrived at by the sequence of artifacts found in floor deposits which had built up until they covered some of the wall pictographs. In other sites fragments of engravings or paintings that had fallen from wall or ceiling were identified and correlated with the layers in which they were found (Laming, 1959; 31–38). In the USSR Karelian glyphs executed on horizontal bed rock that had been buried under shore deposits were stratigraphically dated by Sabbatiev (1967; 115, 118).

Such an approach, however, has no relevance for the Shield paintings. These are invariably situated directly over, or immediately adjacent to the water, in no position to acquire an accumulation of deposits. Yet deliberate deposits have been made. The Ojibway artist Norval Morriseau (1964; 22–33) reports that it was the custom of Nipigon shamans to deposit dogs, guns and other valuables in the water at certain "Offering Rocks" which he refrains from locating. A likely place would have been the deep water off Echo Rock on Lake Nipigon; underwater archaeologists may recover evidence here that can be associated with the few vestigial paintings on this imposing rock. The tobacco offerings deposited on ledges and in crannies of prominent shore outcrops all through the Shield country are too perishable to have any dating value, and are frequently found where there are no pictographs. In the Lake of the Woods country more elaborate offerings are clearly associated with the petrographs (Dewdney & Kidd, 1967; 51–55). These consist of tobacco heaped on peculiar "prayer-rafts" of peeled sticks which in turn are laid on a neatly folded pile of clothing, placed on a rock ledge close to the paintings. But such deposits, washed away by one or two spring floods, have no stratigraphic value, and the cult they reflect may be of quite recent origin. We found no offerings of any kind at the Hickson-Maribelli site.

Indeed, any conclusions about the age of a painting that attempted to relate deposits found in the vicinity of a Shield painting would be based, literally, on the thinnest of evidence. Although paintings in one setting out of three throughout the Shield were made from footholds or ledges above the water, scarcely a dozen are high enough above the normal flood level to have escaped annual washing. Nor does flooding itself leave any permanent deposit of algae or other organic material whose accumulation would overlie the paint and offer an indication of age.

During high water years immersion of a rock face for a full season kills all the lichen growth, to leave a clear high water mark. A number of the Hickson-Maribelli paintings were made below this level on rock faces that had been cleaned off and subsequent flooding seems to have had a minimal effect on the paint. (See also page 57.) New thalluses (Plate 3) had begun to grow, and given time, no doubt they would encroach extensively on the paintings. There is no early information on the frequency of such high water years, but two have already occurred between 1957 and 1970, both affecting the whole of the central and western Shield Woodlands.

At Site #181 the high water mark is only three feet above the mean level for the first week of August, 1963 to 1965 inclusive. Eighteen Faces come below this level. Seven Faces were painted from ledges or rock fall. The remainder could be reached in early August by standing in the canoe, and were doubtless painted from the water in the spring, or in the summer during a high water year.

Opaque white deposits, usually calcareous, occur on most petrograph sites, and occasionally encroach on the paintings (Plate 4), although more frequently the paintings were made over them (Plate 5). This material, dissolved by groundwater and issuing from rock crevices to be precipitated on vertical Faces, seldom amounts to more than a thin film. In the one notable exception, on Picture Rock Point, Lake of the Woods, where it is 2 mm. thick, the paintings overlie the deposit. The great majority of these deposits seem to have been made over a limited period of time, suggesting that the mineral sources in the interior of the rock are so small that the supply is soon exhausted.

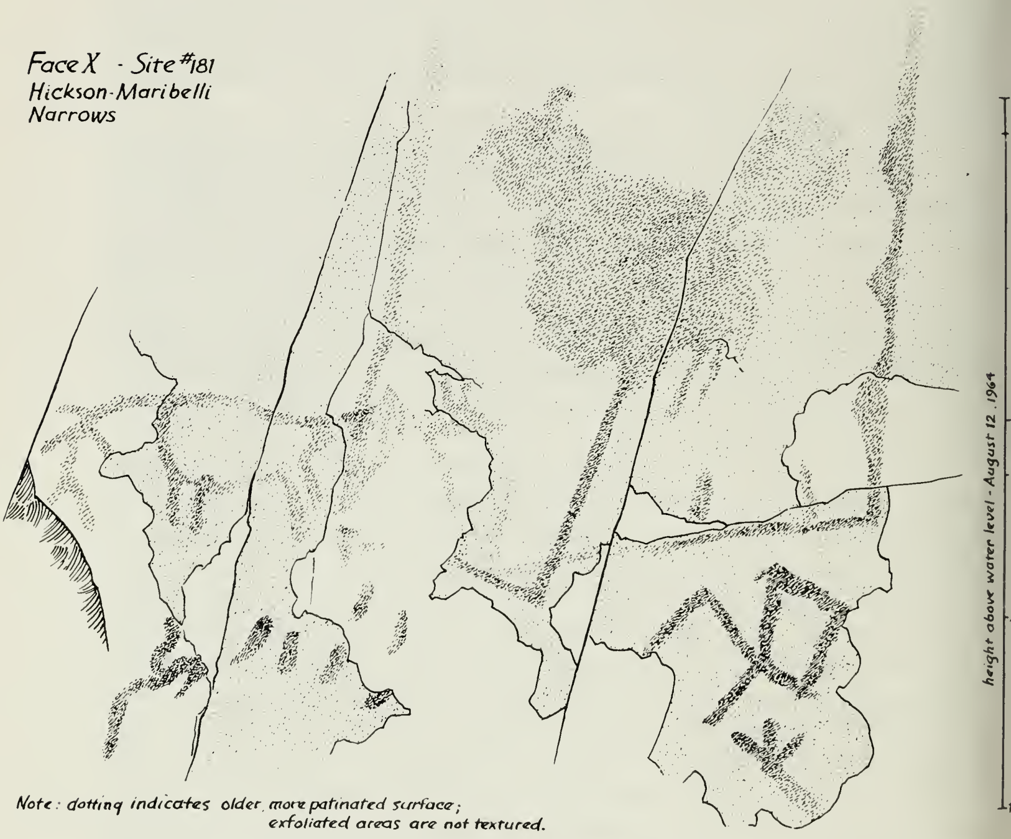
In 1969, after the bulk of this paper had been written I recorded a site on the north shore of Lake Superior at Worthington Bay, the one Shield site known so far where actual deposits of soil overlie an aboriginal rock painting. This petrograph is the lowest of a group painted on a vertical rock face bordering a small beach, but beyond the reach of any normal wave action. Assuming that the Figure was painted from a sitting position, the beach level at the time of execution must have been fully half a metre below its present level. The bed of sand that covers the painting extends the full length of the beach in a deposit roughly 10 metres wide and 120 long, perhaps a metre in depth at its thickest. Contrasting strongly with the dark pebble composition of the wave-washed portion of the beach, it clearly has been washed by highwater action from adjacent deposits at the mouth of a small stream.

SUPERPOSITORY EVIDENCE

The superimposition of one painting or glyph over another, whether by design or accident, is so common in sites around the world that its relative absence in the Shield sites is notable. Where it can be determined which of two pictographs was made over the other a sequence can be established. The French anthropologist, Dr. Leon Pales, has been working for several years on the problem of extracting individual Figures from highly complex palimpsests of engravings on rock fragments from La Marche cave (Pales & Pereuse, 1967; 307–319). During a visit with him, he confessed that he found it next to impossible to determine which lines had been made over others.

In one of the rare examples of superimposition in the Shield (Dewdney & Kidd, 1967; colour photograph, 63) a thin film of lime revealed which was the earlier painting, and microscopic inspection might shed light on the sequence in a few other cases of the kind. An interesting example occurs on Face x of Site #181 (Figure 3).

Here the thin line extending downward from the larger Figure at the upper right, and turning at a right angle to the left, to end on the edge of an exfoliated area, seems to cross, or be crossed by, a much fainter form



Note: dotting indicates older, more patinated surface;
exfoliated areas are not textured.

Fig. 3 Superimposition and exfoliation on Face x, Site #181.

that extends from the base of the vertical scalloped line at the right. But even if we could establish which was the prior painting no useful information would emerge. For neither painting shows sufficient evidence of stylistic affinity with any other painting. The discouraging fact is that, for the Shield sites, style sorting itself is a major problem.

STYLE ANALYSIS

The style or "collective characteristics" (Concise Oxford Dictionary) of the art of a given culture in a given period is difficult at the best of times to distinguish and define, emerging most clearly when widely used stereotypes of form and content, along with their variants, have developed. An impressive example of combining stylistic clues with superpository ones to arrive at a convincing chronology appears in a modest study of petroglyphs by Gebhard and Kahn (1950; 219–228), where a consistent series of overlays both prompted and confirmed a theoretical sequence of styles.

Some Franco-Cantabrian art has been dated by the discovery of style affinities between *art mobilier* on bone, ivory and rock found in stratigraphic deposits and parietal art (Laming, 1959; 37). A most convincing example of this dating approach is the clear identity, not only of style but of precisely similar forms, between Figures painted on rock faces in the eastern Urals north of Sverdlovsk and those on pottery sherds excavated in a nearby stratified site. Chernetsov (1964; 18–22) thus established a date of 3500 years before the present for the petrographs.

But for every clear case of stylistic affinities of this sort there are hundreds that are less convincing, especially if the dated material is turned up unreasonably far from the petrograph site. An extreme example is the speculation of the Abbé Breuil, the pioneer investigator of prehistoric art who laid the foundations for most of what is known about the subject, but who in an unguarded moment of enthusiasm for an extraordinary rock painting in South Africa which he dubbed the "White Lady of the Brandberg," wrote that her costume was "very similar to that worn by the girl bullfighters of the palace of Minos" (1955; 3). Indeed, three Figures in two Shield paintings west of the Lakehead show striking affinities with a half dozen recorded by Okladnikov (1959; 86–90) north of Lake Baikal which offer the same kind of temptation. But a survey of the reproductions of hundreds of Siberian pictographs in publications brought back from the Soviet Union, as well as extensive conversations in Moscow and Leningrad have convinced me that this sparse showing of similarities is purely coincidental. Actually, as one proceeds eastward in Siberia the pictography – whether on bark, wood, rock or metal – becomes less rather than more similar to North American examples.

If, on the other hand, it proves possible to find numerous style affinities between the perishable pictography of boreal North America and the Shield rock art, there would be reason to postulate a recent origin for rock paintings in the Shield region. A few examples do so relate, as Steinbring (1968; 69) has noted.

But even contemporaneous pictographs executed in different media do not necessarily produce affinities of style or content. McCarthy (1962; 69), discussing the relationship between durable and perishable pictography in Australia, warns that "the various strata of religious cults entering into a tribal religion are sometimes associated with different forms of art and all of the latter are not included in the range of subjects depicted on the rocks."

Two style features occurring on Site #181 are comparable with those of the Plains hide paintings or of the Midé pictography of the southern Ojibway: horned figures signifying the possession of supernatural power, and "hour-glass" renderings of the human body. In Figure 4 seven examples of horns – or horn-like projections – are reproduced. The double pair of horns appears again on the smaller site near the end of the Narrows. This feature has been found nowhere else in the Shield, but several examples may be found in the birchbark scrolls of the Midéwewin. Midé influence penetrated the Lake Winnipeg region and the Saskatchewan prairies, but there is no record of its having reached the Churchill River, let alone farther north.

Examples of the only hour-glass renderings among the 16 anthropomorphic Figures at the Hickson-Maribelli site are shown in Figure 5. One of these, the unique creation on Face xiv, is shown in more detail in Figure 6 (see page 20). Elsewhere I have dubbed it a "female shaman," but more in conjecture than confidence. Under-arm projections on either side of the thorax, partially obscured by lichen, might be interpreted as breasts and there is more than a suggestion of a long skirt. In Figure 5 the raised arms appearing in only two of the reproductions occur in eight others on the same site. But this feature frequently occurs in the rock art of other continents and by itself has no dating value. In Face xiv, however, the

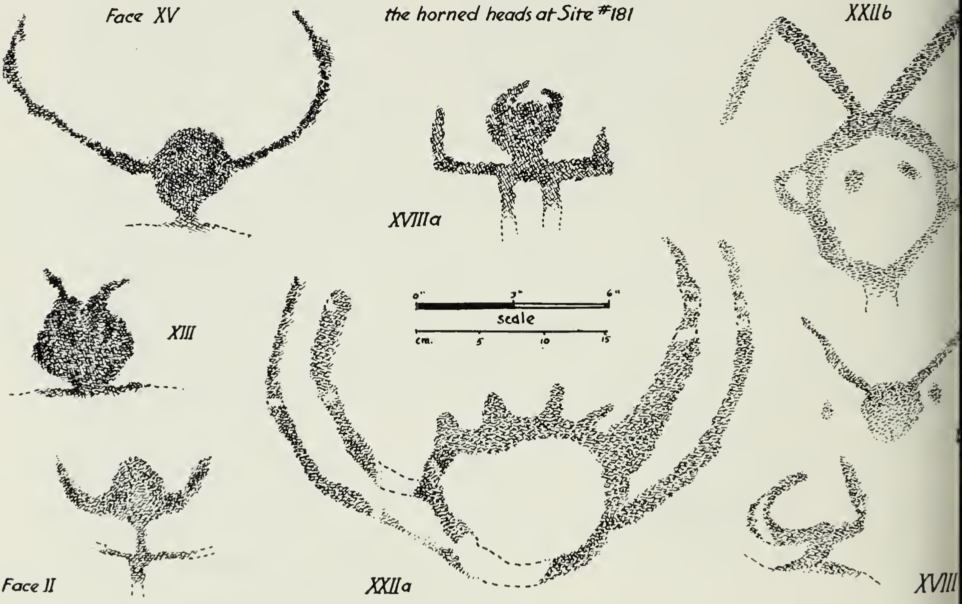


Fig. 4 Symbols of Manito power, Site #181.

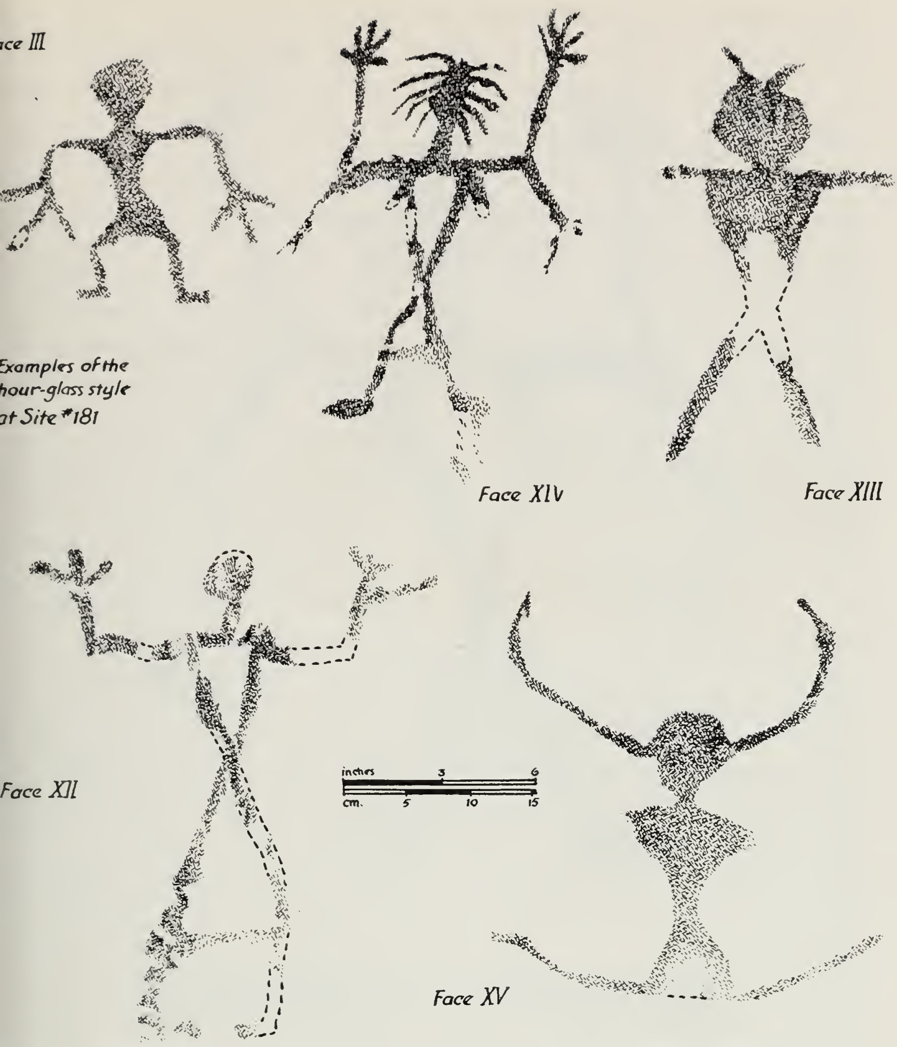


Fig. 5 Figures in the hour-glass style, Site #181.

raised arms are embellished by the unique projections from the elbows. The radiating lines on either side of the head might be interpreted as hair, but are more likely to represent emanations of manito power.

It is too early to discuss in any depth the complexities of sorting out style features in the rock art of the Shield Woodlands. By contrast, in studying the glyphs along the Milk River in southern Alberta (Dewdney, 1964; 22–29) I found it relatively easy to select such stereotypes as the Pointed-shoulder style. This brings into sharp relief how nearly impossible it is to find common features of rendering, paint application, figure treatment or any other aspect of rock art in the Shield region that would validate the grouping of more than a dozen paintings under any single style designation. So far, all that can be said of the rock paintings in the Shield region is that their greatest common style denominator is their individuality.

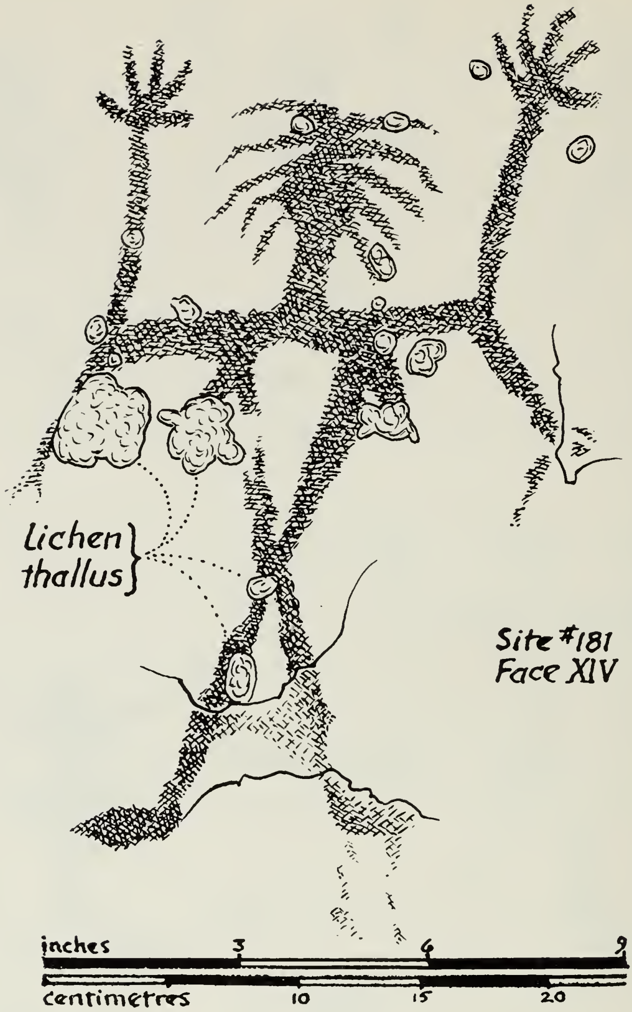


Fig. 6 Shamanistic figure from Face XIV, Site #181.

LABORATORY TECHNIQUES

Today's swift advances in applied science offer a number of techniques that have been useful in archaeological dating, and promise still others. Refinements in carbon-14 tests are making it possible to detect and measure with increasing accuracy, and from smaller and smaller samplings, the residue of radio-active carbon from which valid dates for materials of organic origin can be deduced. Since any binding agent that may have been mixed with a mineral pigment must derive from such organic materials as fish oil, animal grease, or egg yolk (to name only a few possible sources), one should be able, by collecting enough paint, to measure its age by carbon-dating.

Several problems arise, however. Even to collect enough paint to ensure the inclusion of a thimbleful of binder it would be necessary to scrape off an indeterminate number of paintings, without any guarantee that most of the binding agent had not already been leached away by weathering. At best, it would only be possible to establish a mean date for the destroyed paintings, some of which might be quite old, others very recent.

Nor is it even certain that all paintings contained a binder in the first place. At EXPO '67 I simulated some 40 rock painting Figures on granite blocks that supported and surrounded the Ontario Pavilion. A number of these simulations were experimental, painted on blocks fully exposed to the weather. The same red ochre pigment was used for all of the exposed paintings but it was mixed with glue, oil, or varnish, and in two cases with nothing but water. Returning thereafter at six-month intervals I found that the paintings with the glue binder had almost vanished by the end of the fourth interval. Those with no binder, although clearly more impaired than those with oil or varnish bases, remained clearly discernible. The question arises whether in the long term, given the amount of protection typical of the settings of most Shield paintings, there might not be a bonding action between pigment and substrate that would be inhibited by the microscopic film of a binding agent. Certainly the EXPO experiment established that, given protection from the more erosive weathering agents, a painting without any binder might last a long time.

The granite surface of the EXPO blocks, however, was extremely rough. In subsequent field tests at Shield sites it has become apparent that, whether the pigment is applied as a chalk and retraced with a wet finger, or mixed with water and applied as a thin paste, it is impossible either way to make a continuous line on smooth rock. On a rough surface the chalk-cum-wet-finger technique worked; on a smooth face it did not. Obviously the method used to obtain the finger-width lines typical of a majority of the Shield paintings was not as simple as had been assumed; and the possibility must be considered that a primitive brush or some painting tool other than finger or hand was used on occasion.

There are several methods of determining the presence of organic material in small paint samples. *Single beam spectroscopy* can detect traces of organic material, and the *double beam spectroscope* may decide whether this is a surface deposit (airborne spores, algae, or bacterial growth) or is intrinsic to the paint. The *laser beam* can now be adapted to analyze the composition of a paint sample from a mere pin-prick of phased light (Maloy, 1966; 858–869). Another means of detecting the presence of a binder is *chromatography*, a physical technique for separating out minute traces of chemical components. This technique, supplemented with single beam spectroscopy was applied by Royal Ontario Museum experts to paint samples collected from smeared areas in the field in 1958, but only the faintest traces of an organic component were detected.

If the binder contains protein, as in blood or egg yolk, a complex technique suggested by medical research has been devised by Denniger (personal communication; see also Nel, 1966; 28–31) which will detect its presence and determine its age by an assessment of the degree to which the amino acids have deteriorated. This approach involves a combination of chromophotography, light microscopy and chemical analysis. It was Chernetsov's opinion, based on his knowledge that the historical Ob-

Ugrians of western Siberia used blood as a binder, that the petrographs he had recorded had been painted with a mixture of blood and red ochre; yet tests for organic content had been as inconclusive as ours. I have yet to run across a reference to the use of blood as a binder by any tribe in boreal North America. Indeed, since red ochre itself, usually a derivative of haematite and bloodlike in colour, was regarded as symbolizing life, the adding of blood would have been redundant. Bear grease, fish oil, and glue from various animal sources are the binders most commonly encountered in the literature. Isham, for example, (1949; 168–169) observed that "the Glue the Natives saves out of the Sturgeon is Very strong and good, they use itt in mixing with their paint, which fixes the Colours so they never rub out &c." At La Ronge, Saskatchewan, I encountered a Cree, "B-Amos" Ratt, who had water-proofed his paddles, and even painted his cabin, with a paint made of red ochre from a decomposed deposit of iron pyrites on the Churchill River, heated to convert the yellow hydrous oxide of iron into the red, anhydrous one, then mixed with fish oil rendered from whitefish gut. But I would expect the aboriginal painter, if he were an ancestral Algonkian desirous of giving his paint the ultimate in supernatural meaning, to have preferred grease of the sacred bear to any other binding agent.

Corner (1968; 21–24) includes an interesting discussion on paint used in petrographs he recorded in the British Columbia interior, most aspects of which would apply equally to the Shield paintings.

A most promising development is the *scanning electron microscope*. With this instrument a fracture face of rock can be photographed under high magnification with an amazing depth of focus, although not in colour. If particles of pigment and binder can be detected among the mineral crystals they adhere to, examination of a fractured cross-section of the rock and its painted surface should yield a great deal of information, not only about the penetration of the paint and evidence of its impairment, but about the nature of the bonding action itself. It is imperative to reach an understanding of the tenacity of this bond.

WEATHERING AND PATINATION

Chernetsov reports (1964; 17) that "the paint used for the rock drawings is completely *mineralized* [italics mine] and its hardness is no less than that of the rock itself." He cites instances where this is an understatement, for he found a few paintings where the surrounding surfaces had weathered out more than the paintings themselves. Discussing the properties of the paint with him in person I learned that his experience and mine had been identical; to remove paint samples it was necessary to use a steel knife and scrape off the rock pinnacles with the paint. Paint and substrate could not be separated. The groups of petrographs already mentioned (see page 17) dated at 3500 years B.P. had been painted on vertical faces of highly metamorphosed shale in settings very similar to those of the Shield paintings and exposed to roughly equivalent climatic conditions. If the red ochre had indeed been mineralized, the molecules of anhydrous iron oxide, separating themselves from the impurities of the original pigment, must have crystallized to reacquire the hardness of the parent mineral, haematite, which is equal to that of a good quality steel. This theory offers an alternative to an earlier speculation of mine, that there is a reciprocal bonding between traces of iron in the rock and the iron content of the pigment.

Approximately four out of every five Shield sites consist of granitic or gneissic rock. The surfaces frequently reveal that they were abraded, "planed" or even polished by glacial action. Other surfaces vary with the grain of the rock: a fracture plane of pegmatite will be very rough, while that of a slaty schist may be satin smooth. Some rock formations produce a network of surface cracks on exposure to the weather; on others the surface may be intact over large areas. In tying a canoe to the rock wall the first thing to seek is a cranny into which a knotted line can be wedged, or a crack that will take a stick to tie it to. Yet in some sites it has been necessary to use as much as 40 feet of line to reach the nearest flaw in the surface that could be used this way. Granite walls invariably offer the most difficulties of this sort.

The granitic rocks and gneisses commonly reveal the effect of changing surface tensions familiar to anyone who has built a fire on an outcrop of either. In the first stage an invisible lamination occurs beneath the surface and parallel to it. As surface moisture -- to which no rock is wholly impervious – penetrates the lamination, frost action becomes more and more aggressive until a blister is raised, filled with the "sand" of disintegrated rock. Eventually a flake half a centimetre thick, or even a large plate of ten times that thickness, will become detached. This is known as spalling, or exfoliation. Another more subtle effect, which I call "granular fallout," is the result of individual rock grains or crystals becoming detached over the years, particle by particle, through weather exposure. Where cracks occur, especially if they intersect obliquely, frost action finds its maximum opportunities.

The seeming imperviousness of some glaciated surfaces, which we know to have been exposed since the end of the last glaciation, makes it clear that these effects can be exceedingly slow in taking place. But the microscopic evidence must be there, even in the hardest rocks, long before spalling takes place. This can be detected only under laboratory examination..

Yet there are instances where reliable conclusions may be drawn from field observations. Face x at the Hickson-Maribelli site offers an example, illustrated in Figure 3 (see page 16). At the low right the residue of a vanished Figure – probably human – can be discerned on a lightly glaciated surface at the edge of an exfoliated area. This painting must certainly have been made at a time when the spalling rock gave little evidence of imminent flaking off. It is true that the shaman-artists could on occasion be quite indifferent to major surface flaws, but surely not to loosely attached surfaces.

Once a new face has been exposed, whether by extensive spalling or by the splitting off of a rock mass, slow changes take place in the colour and texture of its surface. Such colour changes are known as patination, and may be quite complex in origin. Even before the final exposure the action of frost and groundwater solutions have altered the surface. Oxidation of the iron content produces the dull yellow of the hydrous oxide which may redden as it is converted, after exposure to sunlight, into the anhydrous oxide; or may merely darken if moisture is in good supply, picking up dust or algae from the air, acquiring micro-deposits of minerals dissolved in seepage (which may also – as in the case of lime – lighten the patination), and no doubt also being affected by other as yet unrecognized factors.

In regions where rainfall is scanty and rock faces have year-round exposure to sunlight and wind-driven sand or dust, the variety of patination known as "desert varnish" appears. This has been shown to have dating value by Heizer and Baumhoff (1962; 284–286) in the case of glyphs whose patination contrasts with that of the surrounding rock according to how recently the petroglyphs were chipped away from the mother rock. In my Milk River experience I found a complete correlation between the most heavily patinated rock faces and an "Archaic" style; but this was ensured by the vulnerability of the soft sandstone exposures, which rarely survived long enough to acquire a heavy patination.

The painting already referred to in Figure 3, on Face X, Site #181, is one of the rare cases in the Shield where patination may have some dating value (see page 16). The exfoliated area at the lower right, from which most of the painting has been removed by spalling, does show sufficient patination to indicate that considerable time has elapsed since the painting was impaired. But only a study of the factors involved in this particular setting, when related to similar studies of a number of selected sites, can offer us any idea of what that time lapse was.

LICHENOMETRY

Roland Beschel (1961; 1044–1048) has found that estimates of the age of a number of species of crustose rock lichens can be based on measurements of a single thallus, given optimal growth conditions. Studies now being conducted under his supervision may make it possible to measure the factors that inhibit lichen growth in micro-habitats where conditions are less favourable. One Shield painting in ten shows some encroachment by species for which the optimal growth rate is known, but a majority of these involve thalluses no larger than those obscuring the "breasts" of the human representation illustrated in Figure 6. Here, as in so many cases where lichen encroachment occurs, the whole figure is well under the high water line, which means that it has been submerged long enough during a high water year to kill off any previous lichen growth. To measure the thalluses in such settings, therefore, would merely inform us how long ago the last summer-long submersion took place (Plate 5).

The micro-habitat of the lichen on Face XIV has a moisture supply that is seemingly adequate for lichen growth. If this lichen is *Rinodina oreina*, and its environment does in fact offer optimal growth conditions, the largest thallus on Face XIV has an age of about 50 years. However, in attempting to apply lichenometry to the dating of petrographs we are confronted with two hard facts. First, the factors that inhibit weathering and so preserve the paintings are the very ones that are hostile to lichen growth; so that to take lichen encroachment into consideration we must know *how much more slowly* than the optimal rate the growth of any lichen that does get a foothold will proceed. The second obstacle is the difficulty of giving a time value to the factors – including random ones – that determine how long it will take for algae and fungus spores to lodge in the same rock cranny under conditions favourable for symbiosis.

ETHNO-HISTORICAL EVIDENCE

"La science préhistorique est extraordinairement armée pour donner certaines précisions comme le sense dans lequel on frottait l'ocre sur la palette, mais elle se tait au moment où la main se lève pour appliquer cette ocre et le reste, si l'on veut qu'il existe, doit être fait d'un amalgame d'Australien, d'Ainou et de Peau-Rouge."

Leroi-Gourhan, author of a massive and authoritative work, *Prehistoire de l'art occidentale* (1965; 27) refers here to the major problems confronting students of prehistoric art in southwestern Europe: the vast hiatus of time and information that separates the art itself from living traditions and practices. The fact that aboriginal cultures could be observed in North America before they were seriously eroded by the invading ones is highly significant. For only here, and in Australia, has it been possible to explore in detail the relationship between the durable pictography and the fragile records of preliterate practices and beliefs that have been preserved in the oral traditions, or in perishable pictography, of the sort that vanished in Europe millennia ago. The study of the whole field of pictography in the areas of North America where hunting cultures predominated has therefore a unique value.

Mallery's work (1893) remains the most exhaustive attempt yet made to record and correlate the wide range of preliterate pictography in North America, both in the durable media and in the perishable ones. Yet in his day no more than six of the 300 rock art sites now known to exist in the Shield region had been reported, and none adequately recorded. A revived interest in pictography has been gathering momentum across the continent since 1950, and now extends to the perishable pictographs that have survived in public and private collections. Rich stores of relevant ethnohistorical information, too, still linger in the field or lie buried in the literature.

Campbell Grant (1967; 30), for example, in discussing the diamond-shaped abstraction of rattlesnake forms "which is common in California and is almost the only style found over a wide area," attributes it to the historically recorded puberty rites of Luiseño girls. Had this practice extended far back into the prehistoric period such paintings would have multiplied beyond count, unless weathering proceeded with great rapidity. Grant also quotes James A. Tait as stating that the Salish-speaking Thompson people, both in their puberty rites and as an adult practice, recorded their dreams on rock faces; and Leechman (1954; 77–85) reports that both male and female puberty rites of the Salish included the painting of specific symbols on rock.

In my own field work I have interviewed over 150 informants throughout the Shield Woodlands (51 Ojibway and Saulteaux, 14 Cree-Ojibway, 42 "Woods" Cree, 18 Chipewyan, a few James Bay Cree and Montagnais-Naskapi, and a number of traders and missionaries of European origin) to learn what has survived of traditional beliefs and practices that might relate to rock art in their locality. The great majority of Algonkian informants professed no knowledge of the age or origin of either paintings or glyphs, other than to say something like: "When my grandfather was a boy they told him the paintings had always been there." More rarely I would be told that "a long time ago" the paintings had suddenly appeared.

Everywhere, except east of James Bay, there were occasional but surprisingly consistent associations made between the rock art and the mythical *Maymaygwessiwuk* inhabiting certain "Fairy Rocks," although not all of the latter by any means displayed actual paintings. Roughly half of the few who made such an association went on to state that in earlier times gifted shamans had possessed the power to dream their way into the living rock, to converse and even exchange gifts with these supernatural beings. Elias and Steinbring (1967; 1–4) also report informants in the Lake Winnipeg region who attributed specific paintings to dreams and shamanism.

This does not preclude the possibility that the paintings were already on the rocks when the ancestral Algonkians moved in. But both Steinbring and I have encountered informants who named an actual person as the author of a local painting, suggesting that the practice did not entirely die out until the beginning of the present century. In the Lake of the Woods area the dating of rock art occurrences could establish whether the paintings were made by the Siouan-speaking Assiniboine who appear to have occupied the region prior to A.D. 1700, or by the Ojibway who replaced them.

Such dating might shed light on the obscurity of tribal migrations during the historical period, and possibly earlier. Steinbring and Elias (1968; 501) favour "the growing possibility of Ojibwa inspiration in the Shield petrographs." A few do indeed reflect the influence of the Ojibway Midéwewin cult, notably one on the Bloodvein River in Ontario where a Midé practitioner is represented holding an otterskin medicine bag exactly as portrayed in many of the birchbark "Instruction" scrolls of the Midéwewin. In a current study commissioned by the Glenbow Foundation I have examined over 100 such scrolls in public and private collections as far apart as Denver, Colorado and Edinburgh, Scotland. Of these, five are charts marking the places where the Great Manito's messenger, the Otter (Hoffman, 1892; 179) finds Ojibway settlements along a route on which geographical points can be identified, extending from the Gulf of St. Lawrence to Leech Lake, Minnesota. Whether these charts represent the migration route of a people or merely of a cult, they support an oral tradition still extant in Minnesota among the Chippewa-Ojibway that their ancestors came from saltwater shores in the east (Blessing, 1963; 94). This tradition appears in the literature as early as 1850 (Warren, 1957; 78–80). And, although Hickerson (1962; 404–421) shows that the Midé cult as we know it developed during the historical period, which fully agrees with the evidence of the bark scrolls, he fails to account for the origin or strength of the oral tradition.

There is a fairly impressive correlation between the distribution of rock art in the Shield Woodlands and that of the Midé cult, especially if one accepts the Ojibway tradition of an ancestral saltwater homeland. To date, however, the farthest east the cult can be traced is to Sault Ste Marie. It reached its peak, certainly, in Leech Lake, Minnesota about 1850, whence it spread and proliferated into the rock country as far as the Albany River (north of Lake Superior), and westward to the Nelson River, penetrating the Saskatchewan prairie and Dakota plains with the movements of the Bungi Ojibway. The bulk of the Shield pictographs are scattered through the same area as the concentration of Midé centres. The Saskatchewan rock paintings, however, are distributed far north of the prairie Midé centres, which weakens any speculation that the petrographs might have been "shed," so to speak, as the ancestral Ojibway moved from east to west.

Dating the major Shield sites would have a decisive influence on determining the truth or fallacy of such a speculation. It would also help to sort out (or merely add to) the confusing accumulation of archaeological and ethno-historical information about the Algonkian groups in the central Shield woodlands. For example, Wright (1965; 189–225) points to the inconsistencies between the ceramic tradition and stone assemblage of the historic Ojibway. At least half a dozen other investigators have contributed to the flux of changing views as the complexities of a formerly neglected field begin to emerge.

There can be no doubt that paintings at seven Shield sites were made in the post-contact period. The content is clearly influenced by European innovations: two renderings of firearms, a mounted horse, a boat flying a triangular pennant and another with rudimentary rigging and mast, and a building rendered in the same plan view that is typical of the Midé scrolls but which one might take for an European fort on the basis of the rectangular flag with a ball-topped mast that stands beside it (Dewdney-Kidd, 1967; 50).

At the Hickson-Maribelli site on Face XXVII there is one possible example of a horse and rider which the reader may discover, minutely reproduced in Figure 2 (page 10). I leave him to form his own conclusions.

There is no doubt, however, about the horse and rider shown in Figure 15 on page 43, although the handling of the rider is so inadequate that I question whether the subject was a familiar sight for the artist. This comes from the only Shield site that has been reliably dated, on the basis of an illustration and interpretation published by Schoolcraft (1851; 405–411) which attributes it, and a number of other paintings at Agawa, in Lake

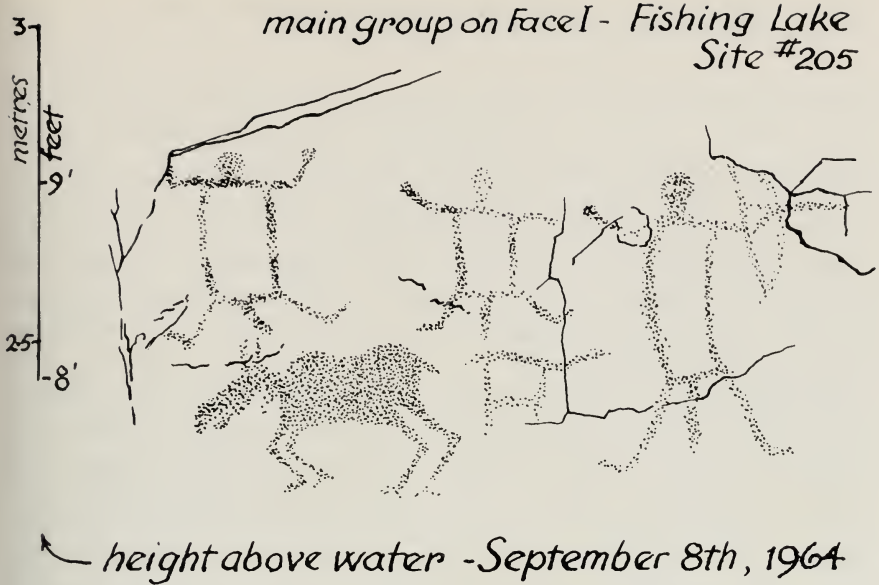
Superior Provincial Park, to a south shore Midé practitioner, Myeengun (Dewdney & Kidd, 1967; 82–84). The evidence points to a date of execution at A.D. 1800, give or take 20 years.

PREHISTORIC CLUES

It is widely known that a number of prehistoric paintings and glyphs, in the Franco-Cantabrian region, the Sahara, the Lake Baikal region, and – more recently – on the European side of the Ural Mountains (Bader, 1965; 28–29) have been dated on the evidence of the fauna they portray; animals that became extinct or changed their habitat at a known time. Nothing of this sort has turned up in the Shield region, excepting the European reintroduction of the horse.

In three Shield sites a bow and arrow is represented, from which some dating inferences may be drawn, although these are highly speculative. The European firearm from its first appearance on the continent (when it was actually a less effective weapon, and certainly a clumsier one) provoked reactions of terror among the Amerindians, who attributed supernatural powers to its discharge and its possessor. In view of this it seems not too illogical to assume that in the rock paintings the more impressive weapon would replace the common one. If that were so the appearance of a bow and arrow in a rock painting might indicate that the gun was still unknown to the dreamer, suggesting a date that was either very early in the contact period, or preceded it. At two of these sites, straddling the Manitoba border and only 20 miles apart, at Frances Lake and on an arm of Fishing Lake, are the only paintings that show full human figures with drawn bow and arrow. Each figure also displays what is presumably an exaggerated phallus, a rarity among Shield paintings, which seldom show any interest in the genital area. These paintings are illustrated in Figures 7a and 7b.

At a site on nearby Sasaginigak Lake a human figure is portrayed with a bow and arrow in one hand and a medicine sack in the other. Elsewhere in the Shield, to my knowledge, there is only one other example of a figure holding a bow, at Manawan Lake, some 600 miles to the northwest, on a source of the Sturgeon-Weir River. There are only two clear examples of guns, both held in a firing position: one on the Churchill River at Stanley Rapids, the other in Ontario on Darky Lake in Quetico Provincial Park.


main group on Face I - Fishing Lake
Site #205
3
metres
feet
9'
2·5
8'
height above water - September 8th, 1964

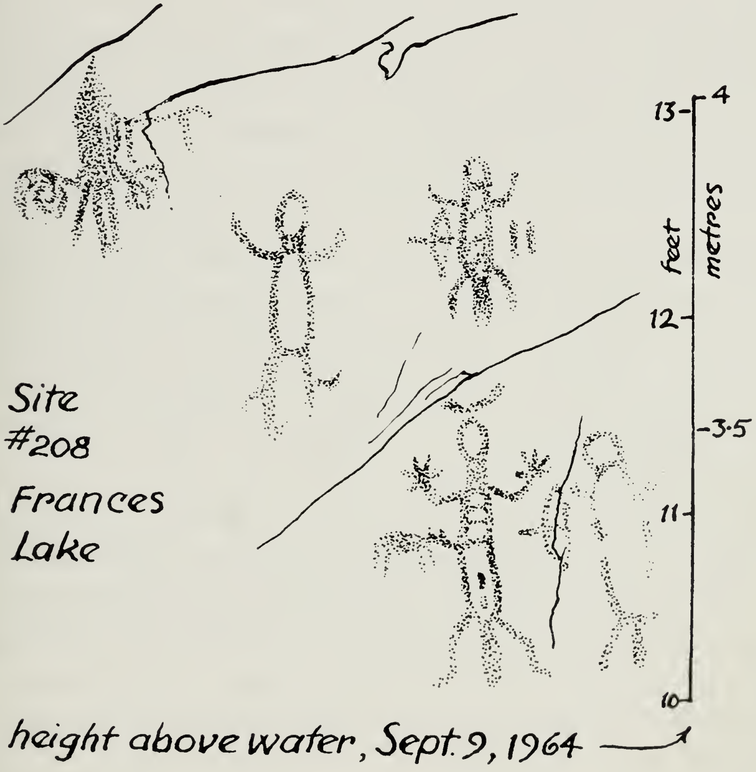


Fig. 7 Paintings at Fishing and Frances Lakes.

The Need for a New Approach

Successes in determining the age of rock art in various parts of the world have tended to obscure a significant fact: that a great majority of the glyphs and paintings on five continents have not been reliably dated. Nor have there been to my knowledge any serious explorations of the dating value of the whole complex of weathering agents and their inhibition that might determine the rate at which a given rock painting (or glyph) will weather. The obstacles to such an approach are formidable. But it appears that any attempt to date the Shield paintings must accept the challenge. There is no alternative in sight.

No studies have yet been undertaken of the effects of short-term weathering on Precambrian rock exposures in Canada. There is, however, an escalating interest among geologists, geo-physicists, geo-botanists and archaeologists in such various aspects of the post-glacial period as isostasy, varve correlation, bog formation and spore identification. Research is also under way on the weather-resistant capacity of various building materials. Since 1959 the Building Research Division of the National Research Council of Canada has established seven sites across the continent to study the impairment of building materials under various types of climatic exposure (Gibbons, 1960; 1–5). Useful information might be obtained by testing prepared samples of native ochres mixed with various organic binders and applied to rock slabs typical of the Shield petrograph sites, using the measurement devices and techniques already in use for building materials.

Such an experimental approach, however, would demand more information from the sites themselves than is yet available. The variables affecting the vulnerability or resistance of a given paint in a given setting can be simulated experimentally only after more exact knowledge is acquired of the key factors involved. Intensive data collection at selected sites, measured or otherwise recorded with maximum accuracy, plus an adequate sampling of the paint and rock substrate for laboratory study, is mandatory.

In this perspective the tentative efforts made at the Hickson-Maribelli site were revealed as both naive and superficial. A serious approach would demand an examination of each painting, its setting and site, in as much detail and with as much precision as are now routinely employed in an archaeological excavation.

A first step, therefore, would be to select the sites that promised a maximum return for such detailed examination. Accordingly I reviewed all the available records, searching for those petrographs that suggested the widest divergence in age, reasoning that if the proposed approach had any validity the results would show up most clearly by comparing those from the oldest available paintings with the most recent.

Selection of a recent site was no problem. Indeed, the only reliably dated site in the Shield region was of recent origin: the group of Faces at Agawa, Lake Superior Provincial Park, already referred to on page 27. In some of these paintings impairment has been extensive; in others surprisingly limited. All seem vulnerable to the full fury of Lake Superior storms, which have a full 400-mile sweep when the wind is from the west (Figure 8). The steel framework shown in Plate 6 had been intended for the base of a catwalk for visitors, but the following winter it was so mangled by the ice (see Plate 7) that the attempt was abandoned.

A site of early origin should combine evidence of considerable paint impairment, a maximum of protection from the weather, and a combination of other factors that were weather-resistant. Two sites that shared a style and content that distinguished them from those of any other Shield paintings, were both impressively protected against the weather, and showed enough obvious impairment to suggest a substantial age. These were the sites already mentioned, at Frances and Fishing Lakes (see page 28). Comparison of the data from them with those from the Hickson-Maribelli site reinforced my subjective impression that the former were much older. A further bias operated in making the choice: the inclusion in both sites of human figures with bow and arrow.

In July of 1968 a contract with the National Museum of Man made field trips to all three sites possible. The Canada Council financed the purchase of equipment advised by Mr. Peter Sereda, Section Head in the Building Research Division, N.R.C.C. Other instruments were loaned by the Geological Survey of Canada and by the Royal Ontario Museum. The objectives of the field work were (a) to review and extend an understanding of all the variables involved in the vulnerability and impairment of the paintings, (b) to record all data that might conceivably be useful for dating purposes, (c) to test the equipment and instruments as to their practicability for accurate recording, and (d) to collect samples of both paint and rock substrate for laboratory examination and analysis. Studies were made at Frances and Fishing Lakes between July 16th and 25th. Work at the Agawa site begun July 30th was cut short two days later by storm conditions that made the site untenable.

On February 20th, 1969, I was able to make a winter visit to the Agawa site, thanks to the Ontario Department of Lands and Forests. Again in July, from the 15th to the 20th, I returned to the site to follow up the previous summer's work. In view of the occasional encroachment on rock paintings by lichen thalluses, and of the strong correlation between the factors that both protect the paint from weathering and inhibit lichen growth, consultations at the site with a lichenologist were highly desirable. Under an arrangement with the Canada Council Mr. Pak Yau Wong, a graduate student at Queen's University who was specializing in lichenology under Dr. Roland Beschel, spent the same period making studies of lichen growth gradients at, and adjacent to, the site, sharing his knowledge of rock lichens and of techniques for recording the factors that affect their growth.

After some general observations about the three sites and their broad environments, the field report that follows will discuss the equipment tested, its usefulness or shortcomings under the varying conditions of each setting, and the conclusions reached as to the most practicable ways of implementing the proposed new approach.

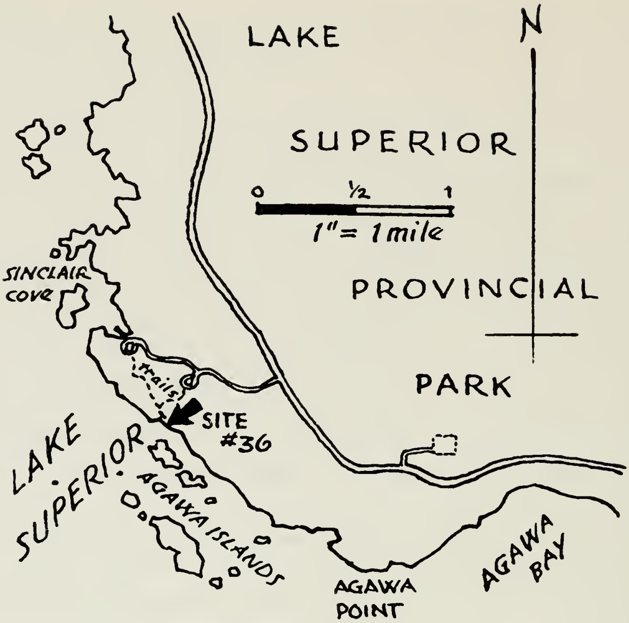


Fig. 8 Map locating Site #36, Agawa.

The Sites

Figures 9, 10 and 11 locate the Frances and Fishing Lake sites. Both are in the heart of territory east of Lake Winnipeg that has been occupied for nearly three centuries by Ojibway migrants from the Lake Superior region. Known as Saultaux, they replaced the earlier Cree hunting bands during the population shifts that followed the expansion of the fur trade into the northwest. Local shamanism, mingled with the Midé practices of the Minnesota Ojibway, is deeply rooted in the region and remains active to this day, centring in Little Grand Rapids, the name of both an Indian Reservation and a trading post and nursing station just south of Fishing Lake. Frances Lake (#208) is 45 canoe miles to the southeast; Site #205 is on one of several arms or channels that extend to the north and east, and are considered to be a part of Fishing Lake.

Both sites when I visited them in 1964 were well above the prevailing, normal water level. 1968 was a high water year, so that the Fishing Lake petrographs were nearly under water, and only the Frances Lake paintings – normally ten feet above the water – could be worked at from a solid footing. My choice of sites was fortuitous, for a majority of Shield petrographs extend to within two or three feet of the normal summer water level, and the water was a full five feet above that level all through the central Shield Woodlands in 1968.

Plates 6, 11 and 12 offer photographic views of the Agawa site. Just north of the Agawa scenic outlook on Highway #17 a gravel road branches

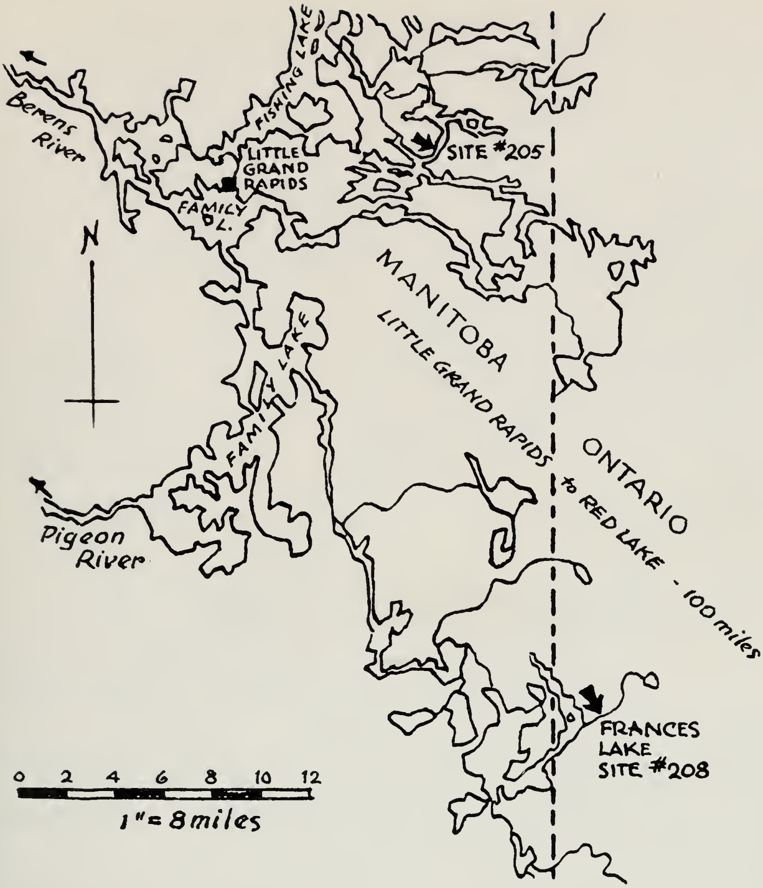


Fig. 9 Map locating Fishing and Frances Lakes sites.

off, leading to Sinclair Cove. Halfway down this road a trail leads from a parking lot down to the rock paintings, and a wide but sloping ledge offers a secure footing on calm days from which to view the paintings. There are eight Faces in all, two of which contain the Figures ascribed by Schoolcraft's informant to a south shore Midé shaman, the only paintings at the site for which a date is known.

These paintings are only 90 miles north of Sault Ste Marie, the first known gathering place of the Algonkian-speaking Saultaux, ancestors of the historical Ojibway (Hickerson, 1962; 96 footnote). As one approaches Agawa from the south, however, the shoreline becomes more and more rugged. By necessity this became the main route of the fur brigades, but it is doubtful whether the aboriginal population was ever more than scanty and transitional. Along the whole northeast shore sheltered beaches are few and far between, summer fogs are frequent, and travel on the open lake hazardous. Inland, the steep gradient of most streams compels the summer traveller to carry his canoe more often than paddle it. The Agawa paintings are the only aboriginal pictographs known along the northeast shore. Only two other sites have been found on the whole lake – both on the north

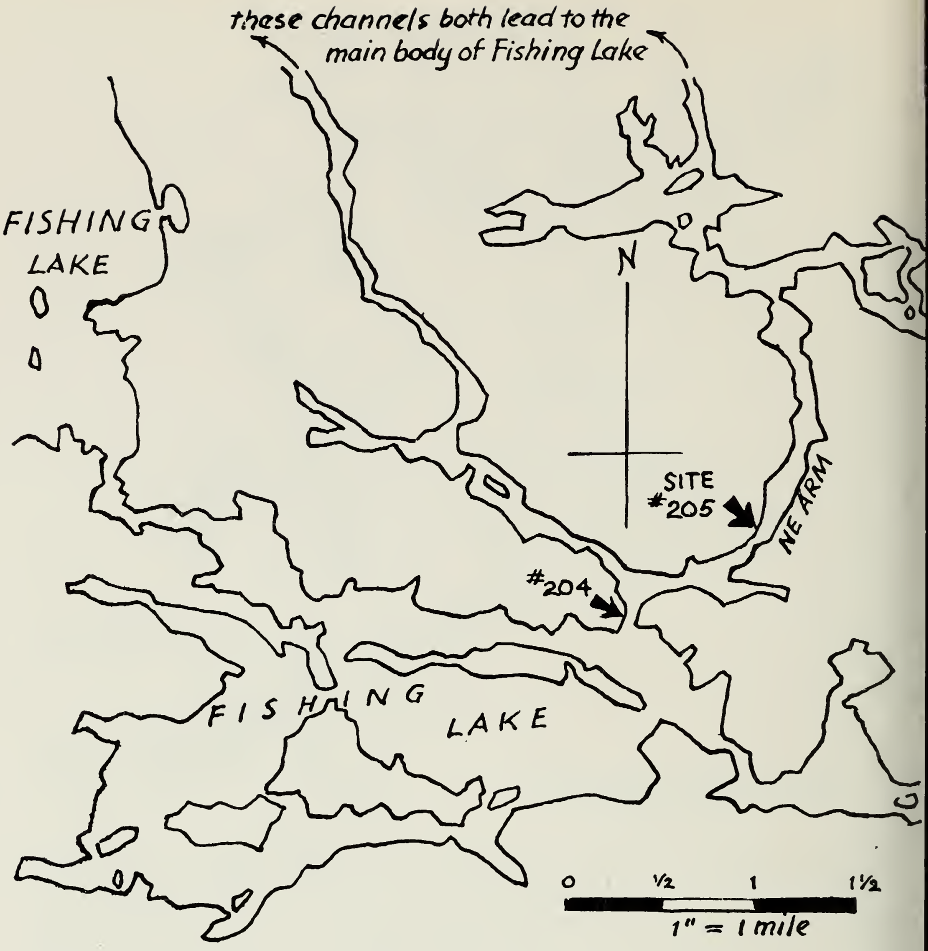


Fig. 10 Detailed location of Fishing Lake Site #205.

shore – in Nipigon and Worthington Bays, some 200 canoe miles distant from Agawa. By contrast the Frances and Fishing Lake sites are in the zone of concentrated pictograph distribution described earlier, and in the heart of ideal canoe country.

The relation of each site to adjacent waters differs radically. At Agawa a small group of offshore islands offers some protection against wave wash from southwest winds (see Figure 10), but a west wind sweeps in unimpeded, and at the height of a storm wave splash is hurled as high as 30 feet above the ledge from which the paintings were made. This contrasts with the Fishing Lake site which is set in a cove of the shore of a channel running north and south, and is subject to only mild wave splash during high water. The Frances Lake paintings are situated on the shore of a small, sluggish creek and are unaffected by wave splash (Plate 8). No attempt has yet been made to investigate early lake levels or patterns of fluctuation between high and low water. The outlet to Frances Lake is narrow and shallow, and might conceivably be blocked to produce abnormal flooding.

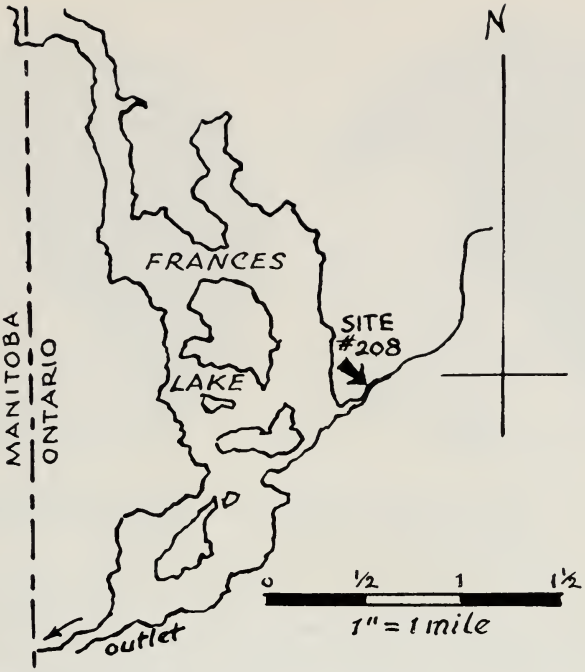


Fig. 11 Detailed location of Frances Lake Site #208.

For example, the high water of 1968 had resulted in floating shore debris from a previous forest fire, some of which was encountered on its way down to the outlet. The narrows out of Fishing Lake are similarly vulnerable to blockage. Lake Superior levels on the other hand would have remained more constant, responding only to general high water conditions.

The geographical location of a site has a distinct bearing on weathering action. Latitude determines the angle and duration of exposure to solar radiation, after allowances are made for the orientation of the setting, the amount of cloud cover, and shade factors such as that of adjacent vegetation or overhanging rock. The prevailing winds, annual precipitation, and number of frost-free days are all significant in terms of the weathering to which paintings in a given site are exposed. Obviously many of these factors cannot be recorded at the site. Fortunately weather records are available at a number of points reasonably adjacent to those sites: at Little Grand Rapids for Fishing Lake, and at Red Lake, Ontario for the Frances Lake site (see Figure 10). Weather records for Agawa are on file in the White River District office of the Department of Lands and Forests.

Table II summarizes the general site data conceivably of dating value. I might add that aerial photographs were taken during the visit to the Frances and Fishing Lake sites to supplement those available in provincial forestry files.

THE SETTINGS – RECORDING OF VARIABLES

For the 1968 field work I was equipped with a Brunton pocket transit, a surface thermometer, a sling psychrometer, a field microscope (X20), an

Table 2

GENERAL SITE DATA

location	*significance for dating study*	*sources of information*
LATITUDE AND LONGITUDE; BORDEN DESIGNATION	for reference to meteorological data on: duration of sunlight, intensity of sunlight, frost-free days, rain, wind, current magnetic declination	Climatological Atlas of Canada, Solar Altitude & Azimuth Charts, Temperature & Precipitation Tables. (Meteorological Branch, Dept. of Transport; also N.R.C.)
RELATION TO ADJACENT WATERS	factors relating to wave-splash, ice erosion and flooding: extent & orientation of associated waters, nature of outlet	field reconnaissance by air & water, aerial photos and information re water levels. (Dept. of Mines & Technical Surveys)
PROXIMITY TO WATER ROUTES AND HUMAN OCCUPATION	presence or absence of human occupation at given periods—historical or prehistoric—may have a dating value	relevant archaeological, ethnological and historical literature.

experimental "splash test" device, and a 35 mm. camera with a wide angle lens plus attachments for flashlit close-ups.

My first concern at each site was to collect data that would provide a basis for calculating the total amount and intensity of solar radiation received by a given face annually. Solar radiation included direct sunlight and, in its absence, diffused radiation from the sky.

To calculate the amount of direct sunlight received by a given Face it was first necessary to know the altitude and azimuth of the sun at the time when it first and last reached the paintings during a clear day. But the time and duration of access is dependent on the nature of the setting. At all three sites various obstructions – mainly rock masses – create an irregular "sky window" which must be taken into account before the accessibility of sunlight can be predicted for every season of the year. I could see no alternative to the slow and difficult procedure of recording the angle to the rock face from salient points of each obstruction, and so laboriously construct the actual horizon as seen from the Face in question. Further, if I were to measure the total of diffused light from the sky, I would need an accurate picture of the whole sky window.

The following winter, however, Beschel informed me of a device that vastly simplified the problem. This was a German instrument, known as a Horizontoscope, designed originally for architects with lighting problems. A transparent plastic hemisphere placed over squared paper (with a spirit level and compass attached for orientation) enables one to see and reproduce the whole profile of the actual horizon from any given point. Trees, rock masses and all other obstructing features show up clearly to outline the whole window of the sky. Figure 12 illustrates the results for Faces I and IIIB at Agawa, taken in 1969.

Transparent altitude-azimuth charts for any given latitude are provided in the Horizontoscope kit, enabling one to calculate the maximum of direct

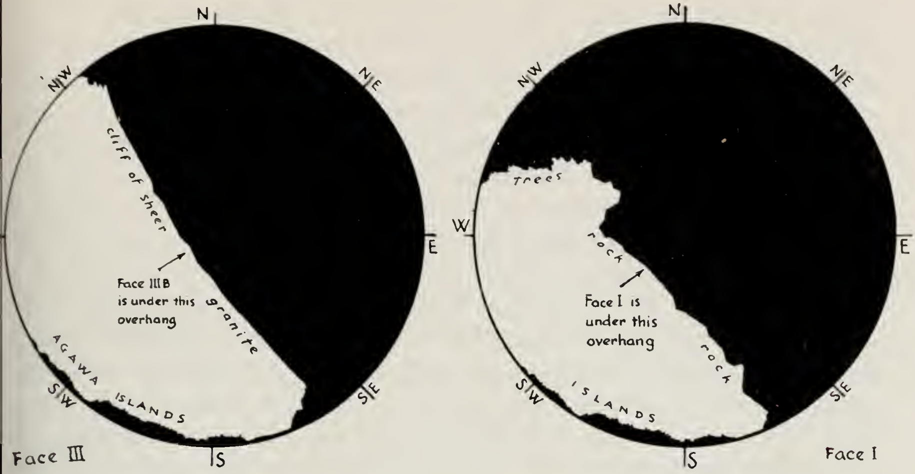


Fig. 12 Horizontoscope readings at Agawa, Faces III and I.

sunlight available annually through the sky window of a given Face. This must be reduced by the ratio between the mean annual total hours of bright sunshine for the site location (Thomas, 1953; 154) and a calculation of the total *potential* annual sunshine, by this means also arriving at the annual total of cloud-diffused light.

A further complication must also be taken into account. The intensity of radiation received under direct sunlight depends on the angle of the radiation to the surface that receives it. It is necessary, therefore, to know the horizontal and vertical orientation of the rock plane on which the paintings occur, and to calculate from this the maximum degree of perpendicularity of solar radiation to the painted surface. I therefore recorded what geologists refer to as the "dip" and "strike" of the rock plane, using the Brunton, which is designed for the purpose.

To determine the actual effect of direct sunlight on the rock surface I made hourly records of surface temperature variations over a 24-hour period at the two western sites; and on my winter visit to Agawa took readings at Face IIIB in the early afternoon, when the sun was at its strongest. The Dependatherm proved to be a very sensitive and reliable instrument. A probe is provided with a copper tip, which must be coated with silicon grease for full contact with a rough surface. The importance of taking rock surface temperatures is to determine how wide a range of temperature occurs as daylight and darkness, sunlight and shade, alternate at a given setting, creating the variations in surface tension that promote exfoliation.

At Frances and Fishing Lakes I took surface temperatures at selected points on the paintings through the night. In both instances, although the sky at Frances Lake was clear all night and cloudy through the night at Fishing Lake, the rock temperature was higher than the air temperature from sunset until after dawn. If these results are characteristic, dew formation on the rock face would be minimal. Indeed, at Frances Lake I found in the morning that although the vertical rock faces were bone dry, a heavy dew had formed on the wooden gunwales and thwarts of my canoe. The wood, in short, had retained less heat than the rock. Figure 13 shows the readings taken between 8.30 hours on July 18 to 11.40 hours on July 19, at the Frances Lake site. The rock surface temperature shown is the average of readings taken at four points on the paintings. Air temperature readings were taken with the sling psychrometer in the air immediately adjacent to the rock. Rotation of the instrument (hence "sling") ensures a maximum of accuracy for the readings.

Agawa site readings taken with the surface thermometer at Face IIIB were 14° C at 13.30 hours on Feb. 20, 11.8° C at 14.00 hours and 13.8° C at 15.00 hours. The prevailing air temperature fluctuated between 9 and 10 degrees C during this period, but in the bush back of the site hovered only a little above freezing-point. Needless to say these were very mild temperatures for the place and season: I had been hoping to get much lower air temperatures for comparison with those on the rock face under full sunlight. Theoretically the widest temperature ranges (given a favourable orientation of the rock face) and consequently the greatest rock surface tensions would occur in winter rather than in the warmer months. A low sun in midwinter could shine with greater intensity on a vertical rock face with a southerly exposure than a "hot," but high, summer sun.

Solar radiation, however, and the associated temperature changes, make their greatest weathering impact when combined with moisture in or on the rock surface. It is equally important, therefore, to assess the amount and composition of whatever moisture reached the painted surface. It is also vital to be able to measure "time-of-wetness," an apt and self-explanatory phrase coined by Sereda (1958; 53–55). Here the variables are complex indeed.

In the studies made at the Hickson-Maribelli site I attempted to record

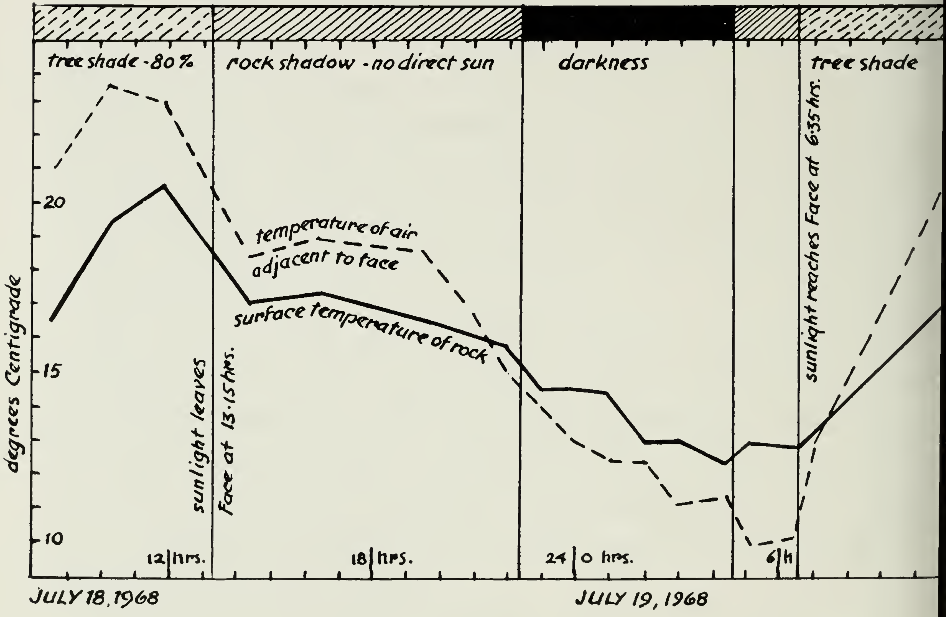


Fig. 13 Comparison of air temperatures with rock surface temperatures, Site #208.

the "protective" features of the pictograph setting that inhibited the water supply. Assuming that dew is a negligible source of moisture on a vertical rock face (which has yet to be proved), there are three main sources: rainwater, groundwater and shorewater. Where, as at the three sites under discussion, either wide overhangs or an outward-sloping rock formation protects the setting from direct rainfall, its vulnerability to wind-driven rain remains to be considered. Figure 14 illustrates the directional distribution of wind velocities and precipitation at Red Lake, Ontario, from April 22 to July 23 of 1968. The wind velocities are charted according to the direction of the wind only on days when rain fell. Over this three-month period sites with a northerly exposure, especially those facing northeast, would be subject to most of the wind-driven rain; southerly exposures, above all those facing south-southeast and east-southeast, would receive the least. Assuming no great difference between wind-rain patterns at the Red Lake weather station and those at Frances Lake 70 miles to the northwest, the paintings at Site #205 would be exposed to very little, if any, wind-driven rain over this period (Plate 9).

The Horizontoscope was not available at the Frances Lake site, but I would estimate from the rough observations I made there, that the light

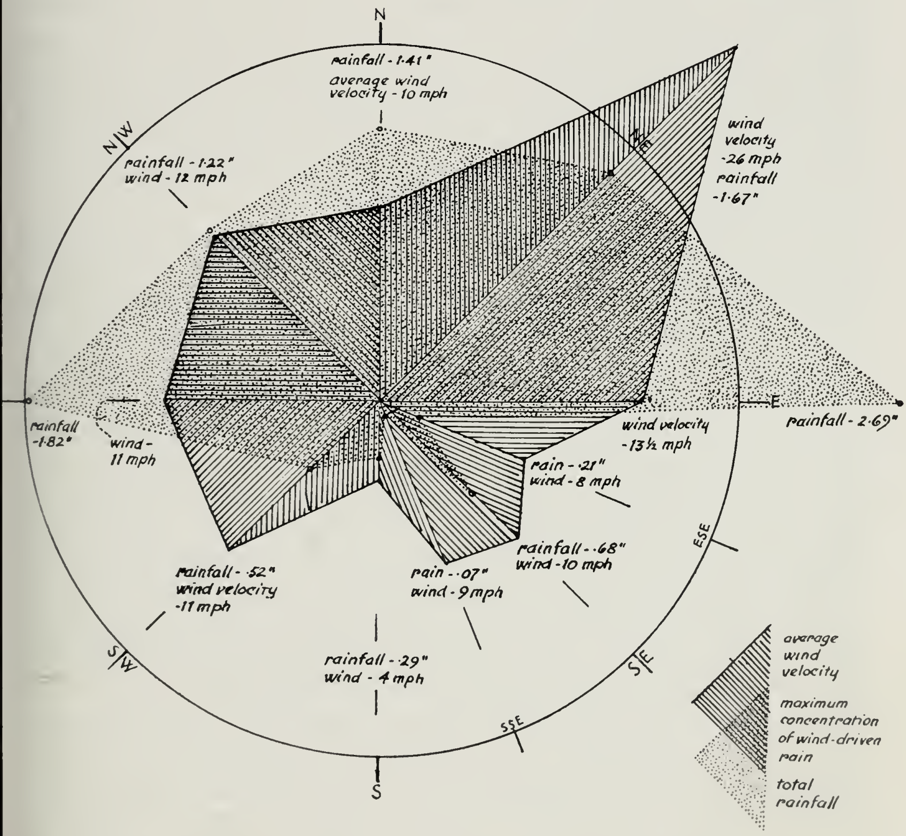


Fig. 14 Directional distribution of rainfall and related wind velocities at Red Lake, Ontario.

window is no more than half of that shown for Face I at Agawa (see Figure 12). A chart of the light window at Site #205 would reveal the extent of the rain "umbrella" provided by overhanging rock and adjacent foliage: observations during rainfall of the wind velocity and direction needed to drive rain under this umbrella would complete the information necessary to estimate the vulnerability of the paintings to wind-driven rain. Should it turn out that there were major discrepancies between the local weather and the Red Lake Station, the weather records at Little Grand Rapids in Manitoba are also available. To arrive at the long range picture it would be necessary to work out the mean annual directional distribution of wind velocities on rainy days together with the total rainfall, and apply this to the directional exposure and rain umbrella of the site.

The same features that protect a painting from direct rainfall will usually also ensure that groundwater dripping from above will clear the paintings. Seepage down the rock face, sometimes emerging from cracks or fissures only a few feet from the paintings, is another matter. The evidence of such seepage, even when the whole setting is perfectly dry, is clear enough as a rule. Where the surface supply of groundwater is continuous, dark patches of blue-green algae thrive, creating vertical black streaks along the surface seepage tracks. Where the supply is less constant, appearing only after rain has fallen, various species of Umbilicaria (rock tripe) grow. Where the supply is even less constant, or the nature of the setting is such that seepage rapidly evaporates, its passage can only be traced by thin films of mineral precipitates, of which the most common is calcium carbonate. Such precipitates would be valuable dating clues but for the abounding evidence that the supply of mineral dissolved within the rock and brought to the surface by seepage is usually limited (page 15).

On the first day at Frances Lake a thundershower precipitated an estimated third of an inch of rain between 12.30 and 13.30. None reached the paintings directly, but two hours after the rain stopped groundwater began to trickle over one of the Figures and by 7.00 the following morning all but a few square inches of the Face were wet. Four and a half hours later, although it was a damp, cloudy day, all the visible moisture had evaporated. At the Fishing Lake site all seepage from above the paintings was effectively diverted by the "lip" of a wide crack just above, which went deep into the rock, offering no further access to the surface before it reached the waterline. On the other hand there was a constant drip from farther up on the rock face which fell clear of the paintings. This dripping was constant for 48 hours after a major storm during which an estimated inch of rain fell. Joe Paishk, my Ojibway camp assistant, explored the terrain above the cliff, to find a natural swampy basin some 30 metres back of the shore which accounted for the constancy of the drip (Plate 10).

The winter's accumulation of snow in such a basin, or even on bare rock above the site, would add to the seepage during spring thaws. Summer observations at the site should provide an adequate basis for estimating the importance of melt-water in the total water supply. Nearby weather stations could supply the mean annual snowfall, which may readily be converted into inches of rainfall, and related as such to the observed contributions at a given rock face made to seepage by summer rain. At Fishing Lake, where vulnerability to groundwater seepage is nil, this factor need not be considered. In other sites an ample supply of moisture in the spring from seepage, combined with the alternate freezing and thawing typical of the season, might prove to be a major weathering factor. At Frances Lake, for example, groundwater appears to be almost the only source of moisture reaching the Face.

The latter site, therefore, demands a visit sufficiently prolonged to record the response of groundwater flow to both heavy and light rainfall. Where direct or wind-driven rain wets the setting the time-of-wetness should also be recorded. A serious omission in the records at Frances and Fishing Lakes was any note of the wind direction during the showers that occurred. Daily records of wind velocity and direction, and of the humidity following rainfall, should also be made throughout the period of field study at the site to determine any variations from data obtained at the nearest weather station.

Wetting from wave splash has already been discussed under general observations, but a footnote might be added concerning the unique winter conditions at the Agawa site. From descriptions by Lands and Forests winter staff I had visualized the whole cliff at Agawa as covered throughout the winter with a thick deposit of frozen wave splash. This was indeed the case at the north end of the site where the rock ledge is well above the water line and provides a secure base for a winter-long ice build-up. As the ledge dips southward along the cliff base, finally to pass under the water, a different situation arises. Normally the water is frozen between the cliff and the offshore islands, but during winter storms this ice breaks up and there is open water to the base of the cliff. Ice sheets from wave splash form on the rock as high as 25 feet, but open water erodes the base, and the first sunny day warms the rock sufficiently to detach the ice. On the day of the visit large sheets were falling off along this section, and Face IIIB had already been denuded of its ice-coating (Plates 11a and b).

This altered the whole perspective on weathering conditions at the Agawa site (Figure 15). Whereas it had been assumed that the entire setting would be buried in frozen wave splash for the duration of winter, with a consequent cessation of any weathering action, it was now clear that there was a substantial difference between the action at Face IIIB, which is exposed to fresh wave splash and wide fluctuations in surface temperature under winter conditions, and Face I, which remains buried under the ice (Plate 12). Under summer conditions exposure to weathering action is reversed. Face IIIB is amply protected from drip and seepage and the rate of evaporation is higher than at Face I, by a ratio of approximately 8 to 5. No rain fell during the nine-day visit in 1969, but on previous visits I had observed that after heavy rainfall groundwater continued to seep over Face I for hours afterwards, whereas Face IIIB remained dry.

The evaporation ratio was obtained during the 1969 observations following a suggestion by Beschel that a series of Piché evaporation gauges be set up along the rock wall. The difference between the evaporation rates at Face IIIB and Face I strongly suggests that the time-of-wetness, other things

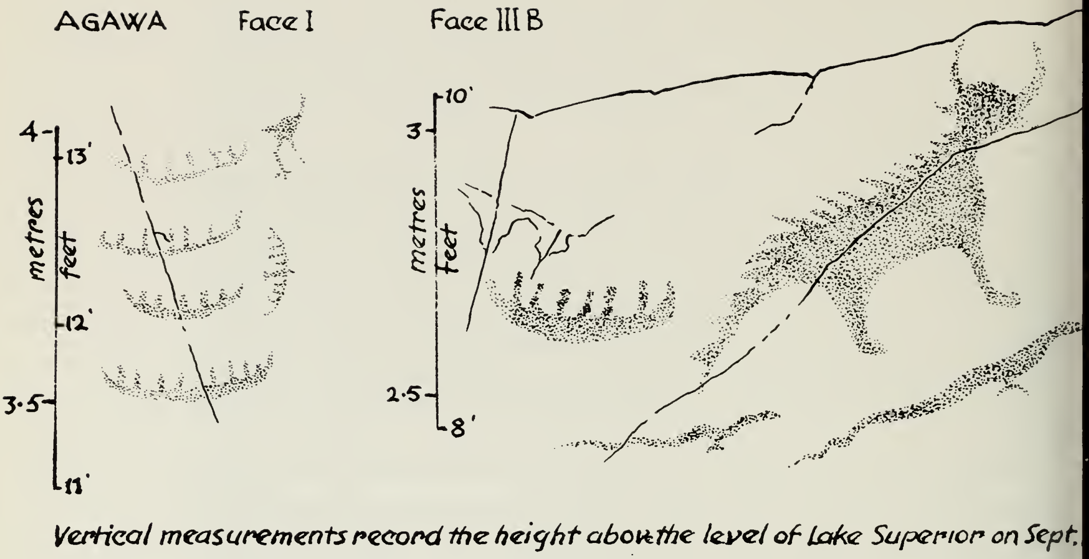
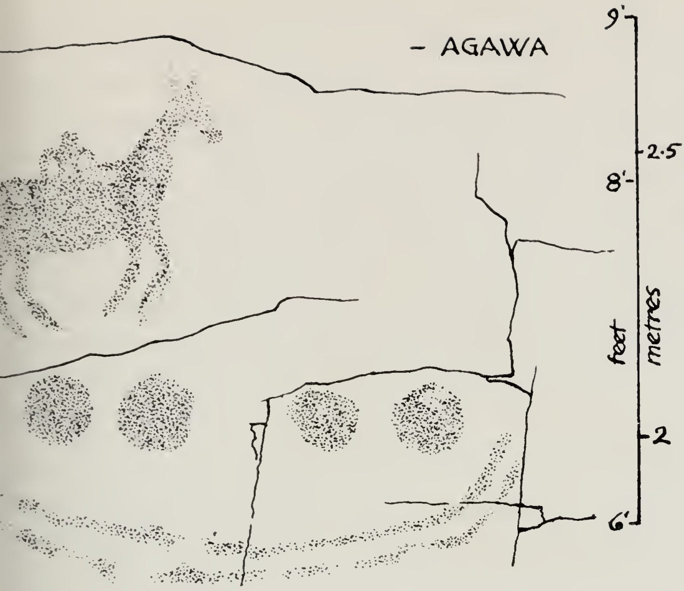

AGAWA
Face I
Face III B
4
13'
metres
feet
12'
3·5
11'
10'
3
metres
feet
2·5
8'
Vertical measurements record the height above the level of Lake Superior on Sept.

Fig. 15 The dated Faces at Agawa.

being equal, will be almost half as much again for Face I. Face IIIB, being closer to the water by two and a half metres, is subject to more wave splash, but is relatively free of seepage. The far greater access of groundwater to Face I in combination with the much lower evaporation rate appears to be decisive, for the Figures on Face I are far fainter than those on Face IIIB. By the same token spalling is almost absent on Face I, and is fairly extensive on Face IIIB, which could be accounted for by the winter fluctuations in surface temperature to which the latter is exposed and from which Face I is protected.

However, another complication enters the picture. Although the evidence (Dewdney, Kidd, 1967; 81–84) is decisive that the paintings at Faces I and IIIB were made on the same occasion, the style of the paintings themselves differs radically, and the possibility is thrown wide open that if two painters were involved, both the pigment and the binder used could have varied widely.

During the 1968 study I experimented with a method of measuring the factors involved in time-of-wetness on the rock face itself, using a hypodermic needle fixed to an improvised wire frame that kept the nozzle of the needle at a fixed distance from the rock face. By projecting a splash of water horizontally to the rock surface a standardized test might be devised to compare the potential time-of-wetness of one rock face with that of another. Projecting a thin stream of water with moderate force formed a splash which almost immediately ran out at the bottom to form a drip track below. The length of the drip track would be governed by three factors: the amount of water discharged, the texture and absorptive capacity of the



rock surface, and the pitch (i.e. angle to the vertical) of the rock plane. If the amount of water discharged and the pressure that discharged it could be standardized, then the capacity of the rock surface to retain or reject water from rainfall, drip, seepage or wave splash could be measured. Further, by timing the period it took for the whole pattern to evaporate, a time-of-wetness scale for a given temperature and relative humidity could be arrived at.

The experiments in 1968 were encouraging enough to have a test model made, and the improved device was tried out again in 1969. Plate 13 shows a splash and drip pattern at Fishing Lake. Here the surface was so absorbent that the drip track spread laterally, shortening its length. At Agawa the drip track was extremely narrow and reached three times the length. Relative humidity readings were taken in conjunction with the test, for correlation to arrive at a standardized "time-of-wetness quotient." As the device now stands it is equipped with three legs, one of which can be adjusted so as to ensure that the needle will be horizontal while all three legs are held firmly against the rock. A spirit level must be fitted to the frame, and a spring and trigger devised so as to produce a standard pressure on the ejected stream. I found that the discharge of .30 cc. of water was sufficient to produce a drip track that ranged between 4 cm. in length on the more absorbent surface at Fishing Lake, and 15 cm. on Face IIIB at Agawa. A greater discharge is inadvisable in view of the limited dimensions of some settings. At Agawa we were equipped with a stop watch, and measured the time it took for the drip track to be completed from the instant of impact. We also measured the time-of-wetness – the interval between impact and the apparent disappearance of all traces of the drip track by evaporation. The latter varied radically from Face I to Face IIIB, confirming the humidity gradient established by the evaporation gauges.

Physical and chemical changes in the paint and rock substrate are obviously influenced by the quality of the water supply. The foremost need here is a test for acidity. At all three sites I used a pH hydrion strip to compare the acidity of rainwater, shorewater and groundwater, with uniform results for each that are difficult to account for. One would expect, for example, to find a sharp difference between groundwater which left a film of lime precipitate over the paintings, and rainwater. Probably the paper test is too coarse to reveal the differences. Groundwater tests present some practical problems as well, particularly when no samples can be collected during a long dry spell. Steinbring and Elias (1967; 6) suggest that it may be necessary to trace the groundwater back to its sources and determine the acidity of each source. This I would judge to be impracticable, nor would it necessarily provide accurate information about the acidity of seepage when it reached the paint. Beschel's suggestion appears to be a more efficient approach: to grind up a surface sample taken from the rock adjacent to a painting, add water, and then test for acidity. This has the advantage of measuring the total acidity present in the rock surface, combining the accumulated effect of the whole moisture supply with the acidic or basic balance of the rock itself.

The major physical effect of water on the painted surface and rock substrate is likely to be from frost action. Since the alternation of surface temperatures above and below freezing point is most frequent during the spring and fall seasons it is important to make records of what happens then. This could be done by setting thermographs at selected sites, and correlating the results with daily maximum and minimum temperatures at the nearest weather stations. The knowledge gained of typical temperature fluctuations at these sites could then be extrapolated for other sites from routine records of nearby weather stations. Information about the moisture supply at a given Face, combined with such temperature data, should then make it possible to assess its vulnerability to frost action.

Brief winter visits to sites on Horwood Lake southwest of Timmins, Ontario, and on Pictured Lake, near the city of Thunder Bay, when added to the Agawa experience, provide convincing evidence that more knowledge is needed of winter conditions. Where snow drifts or ice accumulations preserve a fairly constant temperature and dryness throughout the winter very little weathering will result; exposure to the sun and seepage from melting snow would promote weathering. Observations at a few representative sites, including surface temperature readings, should provide a sufficient basis for assessing winter conditions in other sites, given the information about a particular Face and its setting that can be collected during the summer season.

Ice erosion is another factor of some possible relevance. At the Hickson-Maribelli site the flood-prone levels where many of the paintings appear reveal an apparent deterioration of the paint as it approaches the normal water level, which may be the result of shore ice action during the spring break-up. It is at least equally probable that fine sediments suspended in the water, or algic growths, may merely have laid a film over the paint. A striking example of the effects of long immersion was recently brought to my attention by T. E. H. Jones.

A control dam at the outlet of Horwood Lake in the Gogama district of northeastern Ontario has raised the water 20 feet above its former level. As winter proceeds the dam is lowered, until by early April, the lake is back to its original level. This exposes rock paintings in Hardiman Bay that were photographed by J. A. Macfie (1959; 17), and recorded by me in the early spring of 1963 before the ice went out. While there, a search was made along the shore for traces of other petrographs but none was found. However, a nearby rock face, where ice still clung to the rocks at the summer level, was photographed and reproduced to show the contrast in levels (Dewdney & Kidd, 1967; 150).

By coincidence, in Saskatoon, Saskatchewan, Jones had been shown a photograph taken in 1922 by C. G. Riley of the same rock face, in which a large group of paintings strong enough to show up in a black and white photographic print can easily be discerned. Presumably, had we searched more carefully, traces of these paintings might have been found. But this does not answer the basic question: how could one group of paintings remain easily discernible while others a mere 25 yards farther along the shore have become so faint as to escape my eyes and those of three Lands and Forests personnel? Possibly, in spite of an equal period of immersion, sedimental or algic materials were more heavily deposited on the one site than on the other. Perhaps differences in winter weathering would account for this. In any case the site demands further investigation, and the answers that result should be revealing.

The variables involved in the weathering of paint and rock substrate must include not only those related to weathering agents but to the nature of the pigment, of the bonding process and of the rock. The splash test already described takes into account the texture, absorptive capacity and pitch of the rock surface. A way of measuring the texture of the rock surface was tried out during the visit to the Fishing Lake site. The method tested was to chalk a specific area of the surface and make a photographic record. An absolutely smooth surface would be completely chalked over; one might have valleys numerous and wide enough that the chalk would rub off on only 25% of the surface. By chalking an area of, say, 25 square cm., and placing a 5 mm. grid over it, one could easily arrive at the percentage of chalked area, thus measuring the smoothness with some precision.

Where a film of precipitated mineral lies over the rock surface it can be tested for lime by a touch of hydrochloric acid, which effervesces in contact with calcium carbonate. Surprisingly, while a white deposit at the Worthington Bay site produced the expected results, a thin film from Agawa showed no reaction. Indeed, tests of the pigment itself – assumed until recently to have been invariably an impure anhydrous iron oxide – has been called into question by tests conducted by Elias at a site in Manitoba (personal communication), where a test for iron on a paint sample was negative. The technique has been described by Steinbring and Elias (1967; 5–6).

Lichen encroachment occurs on no Face at any of the three sites intensively studied. At Agawa, however, Wong demonstrated his technique for recording the dimensions of rock lichen thalluses, using a nylon-point pen on a light-weight acetate sheeting. Saran wrap is too yielding, and rice paper not transparent enough for the purpose. For comparison I used Conté chalk on wet rice paper to trace a few of the lichen thalluses Wong had reproduced by his method, and found his to be far more precise. Where it is impossible to remove lichen samples for laboratory identification it is sufficient for most rock lichens to take colour photographs at 0.5 metres.

In view of the variations of mineral content even among granitic rocks no standard scale of patination can be devised. Photographs of fresh fractures and of patinated areas on a given Face offer some indication of the degree of patination for that Face. At Fishing Lake, however, I found that surface weathering penetrated the surface by as much as 2 cm., and care must be taken to ensure that a fresh fracture goes deep enough to measure the colour of the mother rock.

Latterly an original skepticism about the value of recording the nuances of colour for each painting has been modified. The red ochres vary from orange tints in pigment that (presumably) carries a high percentage of the anhydrous yellow oxide, through the reds to a slightly purplish red. The colour is dull or bright according to the degree of impurity present, strong or faint according to the original strength of the pigment or the extent of weathering on the paint. There is also the possibility that the paint may *increase* in colour intensity in the complex interaction of solar radiation, moisture and the minerals in the rock. Occasionally the pigment may be traced to a local source, as noted on an earlier page; but at the Hickson-Maribelli site a wide variety of pigments was used, suggesting many sources. If Elias's negative results for iron in the paint used prove to apply to more than the exceptional petrograph, colour quality will become an exceedingly important feature to record. In addition Elias has developed an electronic device, the "Elias Colour Reflectometer," to measure "the intensity of the light reflected from the rock surface and the pictograph," so that "in this way the differing colour intensities on different parts of a painted figure or a group of paintings can be described in terms relative to each other" (Steinbring *et al.* 1969; 19). Subtle films of mineral or organic deposits might also go undetected without taking cognizance of colour nuances.

At Frances and Fishing Lakes and at Agawa colour photograph scannings were made of each Face under study with a wide angle lens at 0.5 m. In 1957 and 1958 I tested various kinds of colour film and filters to determine which brought out the reds most strongly, deciding on Anscochrome without any filter. In the field, with no control over lighting conditions and the need for varying apertures and lengths of exposure, colour photography is too subjective for comparison of colour at one Face with that at another. At Frances and Fishing Lakes flash equipment was used, which should theoretically cancel out varying local light conditions. However, light from a single direction will not ensure a true colour response; a *double* source is essential to cancel out the shadows of rock pinnacles on rougher rock surfaces. This point is high-lighted by a rock painting in Devil's Bay, Lake of the Woods, which has the unique property of disappearing when direct sunlight alters the contrasts, and reappearing under diffused light from an overcast sky. This effect was probably not contrived; rather it developed as the original paint was thinned down by weathering to a very faint contrast.

At Agawa an attempt was made to match the paint with variations of the red series of the Munsell Colour Chart. These proved to be unsatisfactory for identifying the colour nuances of the paintings. Colour reflected from the smooth printed paper surfaces of the Munsell colour samples differs too radically from that reflected from a rough painted surface. Further, the samples are too small. It is well known among artists that a large and a small area of an identical colour appear to the eye to have different values.

In examining a given painted surface, a 20X field microscope provides insufficient magnification to judge whether the pigment itself is weak or whether an originally strong pigment has been thinned out by weathering, and adequate lighting can be a problem. Under this degree of magnification one gets the impression that the paint is a *stain* rather than an opaque substance, but Sereda pointed out to me that this transparent effect could be due to extremely fine particles of pigment becoming lodged in miscroscopic crannies. With higher magnifications and adequate lighting more might be learned at the site, but the practical problems are numerous and it is obviously desirable to study samples in the laboratory to arrive at any reliable understanding of the nature – whether chemical or physical – of the bonding of the paint to its rock substrate.

The need to collect samples from the site is reinforced by the necessity of deciphering the effects of what might be called "micro-weathering" on the rock itself. Such collections are practicable, although not always easy. Some granite walls offer a dearth of cracks or crevices where samples can be chipped off with a cold chisel and/or geologist's hammer, and there is always the hazard of seriously damaging the paintings. Yet a diligent search at all three sites revealed small areas of exfoliation where a minute but adequate chip of paint-bearing rock could be pried off with a minimum of impairment of the painting. Frequently gentle action with a knife blade was all that was necessary, and only twice was a small rock blister broken open to obtain a sample. This could be rationalized in the knowledge that in time such chips would flake off and be lost in the water. As a precaution against losing the samples so removed it was found wise to lay a strip of masking tape over the flake to be removed, to which it would adhere after detachment.

Both the Frances and Fishing Lake paintings and those at Agawa are normally well above the water level and can be worked at from a dry and secure footing. However, at the Fishing Lake site under the abnormally high water conditions in 1968, it was necessary to work from the canoe, with the bow lodged somewhat insecurely on a large piece of partially submerged rock fall and the floating stern secured to the rock wall by lashing to a stick jammed into a convenient crevice. A majority of the paintings at the Hickson-Maribelli site – and two out of three sites elsewhere in the Shield – can only be worked at from the water. At such sites – and even at those "dry" sites which provide precarious footing – setting up instruments presents a problem. Water depths vary greatly from site to site. At some it would be possible to build a scaffold to support a platform above the water level. At others it would be necessary to use a floating platform, and at others again one suspended from above. Time consumed in this sort of construction suggests that sites selected for intensive study should be those where paintings are concentrated, as at the Hickson-Maribelli site. There are conditions, too, where it is mandatory to have an assistant, if only to help hold an instrument – a transit, for instance – firmly in position while measurements are being taken. But all such problems can be handled with a little ingenuity and an adequate time allowance at the site.

Discussion and Conclusions

Table III provides an inventory of all the known variables at Shield petrograph sites that have emerged from the field work described above, each item of which may conceivably have some relevance to the kind of dating approach envisaged in this paper. It lists the data that may be recorded, suggests the sort of equipment that would be required for the purpose, and evaluates the listed data as a means of determining the *vulnerability* of a given rock painting to the weathering processes.

The evidence of *impairment* of the paint or its rock substrate that can be obtained by direct observation in the field is highly subjective. Only through the collection of samples at the site, and intensive research on these samples in the laboratory, is the degree of impairment likely to be assessed with any accuracy. Nor is it by any means certain that all samples will show the same kind of impairment. It may very well be that the apparent fading of some paint may be due to the slow build-up of a film of mineral deposits under which the paint has remained intact. In other instances there may be subtle molecular or sub-molecular interactions between the constituents of the paint and its substrate whereby the colour may deepen or darken with time, or even – as Chernetsov (1964; 17) has suggested – "re-mineralize," and recover the structure and hardness of haematite.

Table III illustrates the danger, in the anxiety to overlook no significant variable or interrelationship of variables at the site, of compounding complexities by compiling mere masses of unassimilated data. This table is not intended to be the basis for creating elaborate field recovery forms. Rather it is an attempt to assess the variety of possible probings into a field of research that is dominated by unknowns and to suggest some of the tools that might make such probings practicable. As laboratory study of samples proceeds clues should emerge as to which variables are most significant, and recording procedures at the site should become more selective and less elaborate.

A method of correlating a group of variables at one site, so that they may be compared with the corresponding variables of another, may prove to be impracticable. Possibly a formula for a "vulnerability quotient" may be devised. If it can be demonstrated in the laboratory that there is actual impairment of the paint – either directly, or indirectly by erosion of the rock substrate – we might arrive at a simple formula:

$$\text{RELATIVE AGE} = \frac{\text{DEGREE OF IMPAIRMENT}}{\text{VULNERABILITY QUOTIENT}}$$

That is, those paintings that are impaired in spite of a low vulnerability will be older than those with the same degree of impairment that are far more vulnerable to the weather. To all appearances the Frances Lake paintings and those on Face IIIB at Agawa are about equally impaired; but the vulnerability of the Frances Lake paintings is clearly far lower than that of the Agawa paintings, so they should be much older. Yet we cannot judge by appearances. Here the laboratory findings are critical; there is no other way of assessing impairment. If, however, it can be shown that some paintings improve, so to speak, with exposure, the concept of impairment may prove to be misleading, and we may have to think rather in terms of "evidence of change."

In 1966 the two smallest Figures on Face IV at Agawa were given an experimental coating of silicone by a Parks official of the Department of Lands and Forests. This will at least make it easier to remove any defacing paint without damaging the aboriginal paintings. Only time can tell how weather-resistant the silicone will be, which will depend on the depth and tenacity of its bonding to the aboriginal paintings and to the surrounding rock. Time will determine, too, whether the silicone maintains its transparency.

Twenty-five years before there was any public access to the Agawa site by land the fifteen-year-old daughter of the commercial fisherman then operating out of the Agawa Islands splashed her initials in black paint over the Figure of Mishipeshu on Face IIIB. Obligingly she added the date below – 1937 – thereby providing the means of comparing the durability of the commercial paint with the native one. Already the latter is showing through the former, which is so much more vulnerable to weathering that it promises to disappear altogether by the end of the century.

The attack on the problem of dating the Shield petrographs must be three-pronged: in the field, in the laboratory, and at the desk.

This paper has been mainly concerned with the selection and measurement of field data at the sites. But it is vital to continue and extend ethnographical studies in the field, collecting the residues of lore and information that relate to the significance or origin of rock art throughout the Canadian Shield Woodlands. Field work would also include the search for and study of the more elusive petroglyphs. Not all the techniques devised for research on the paintings will apply to the glyphs, but information about either is likely to offer new insights into the other.

Future collections of data and samples in the field will be of little dating

Table 3

OBSERVATIONS AND SAMPLING AT THE SETTING

Variables involved	*Data to be recorded*	*Equipment required*	*Relevance of variables to weathering: vulnerability or impairment*
WATER ACCESS			
a. rain-shadow boundary	*angles* of "rain umbrella" blocking wind-driven rain.	HORIZONTOSCOPE	affects vulnerability to wind-driven rain.
b. shorewater access	*height* of Face (top & bottom) above mean mid-summer level.	TAPE MEASURE	affects vulnerability to wave-splash and flooding
	orientation of Face to shorewater, and extent of latter.	BRUNTON TRANSIT	
c. groundwater penetration	*time-of-wetness* during and after precipitation.	TIMEPIECE	affects time-of-wetness.
	inches of rain, *notes* on dry lime & lichen growth patterns.	RAIN GAUGE	
d. dew & evaporation factors	*rates* of evaporation throughout setting.	PICHÉ EVAPORATION GAUGE	relates to dew precipitation, and evaporation rates.
WATER RETENTION		BRUNTON TRANSIT	
a. surface absorption	*ratio* of spread to splash after impact;	SPLASH TEST DEVICE	absorptive capacity of rock affects depth and degree of frost action and run-off; angle of rock affects run-off; evaporation rate affects time-of-wetness.
b. run-off factors	*length* of drip-line; *angle* of rock face to vertical	STOP WATCH	
c. evaporation rate	*time-of-wetness* of splash, in *minutes*.	TAPE MEASURE	
ACIDITY FACTORS			
a. rainwater	*readings* for each.	METROHM pH METER*	acidity of moisture supply, related to composition of the rock substrate, is a major vulnerability factor.
b. shorewater		pH HYDRION STRIP	
c. groundwater			
d. rock substrate	*samples* for laboratory analysis.		

SOLAR RADIATION			
a. horizon contour	*graph* on altitude-azimuth chart of actual horizon.	HORIZONTOSCOPE, LIGHT METER WITH INVERCONE BRUNTON TRANSIT DEPENDATHERM SURFACE THERMOMETER, WITH PROBE & SILICON GREASE	actual horizon determines access of solar radiation (diffused & direct) throughout the year; light meter enables a comparison of total light inflow of one setting with that of another; shade factors modify this; orientation of rock face determines intensity of direct sunlight; temperature fluctuations promote spalling.
b. semi-shade factors	*notes* on obstructing foliage.		
c. light inflow	*readings* on light meter.		
d. rock plane orientation	*angles* ("strike" & "dip") of rock plane.		
e. surface temperatures	*readings* on surface thermometer.		
ATMOSPHERIC FACTORS			
a. cloud cover	*hours* of cloud cover, and density, per day.	TIMEPIECE SLING PSYCHROMETER	air temperature and humidity changes relate to evaporation rates and to rock surface temperature changes.
b. temperatures	*degrees*, read hourly.		
c. humidity	*percentage*, read hourly.		
PAINT AND SUBSTRATE			
a. colour	colour temperature *readings*. hue, chroma and tone value *readings* on Munsell scales.	COLOUR TEMPERATURE READER, MUNSELL CHART,	colour intensity may relate to degree of impairment by weathering.
b. fade-gradation	*ratios* of colour strength variation on single Figures.	FADE-GRADATION DEVICE (Elias)*	fluctuations in strength of the same paint in a single Figure offer weathering clues.
c. patination	*ratio* of colour of paint to colour of rock surface. *reaction* to iron test; *sampling* for laboratory study.	IRON TEST KIT (Elias)*	presence of iron relates to the degree and colour of patination.
d. weathering impairment of paint and substrate	*photographs* of gross effects; *samplings* of rock suitable for sub-surface study in laboratory.	CAMERA & COLOUR FILM	photographs of sample *in situ* necessary for laboratory study of weathering impairment samples.
e. bonding action	*sampling* of paint & substrate for laboratory study.		samples essential for laboratory study of bonding process.
f. lime deposits	*tests* for presence of calcium carbonate.	TEST KIT – $HClO_3$ (?)	lime overlays retard weathering by protective film and alkalinity; photographs for identification; samples & measurements clues to age.
g. lichen encroachment	*diameter* of thallus; photos in colour at 0.5 m. for identification.		

*not tested by author.

SAMPLING EQUIPMENT INCLUDES: LIGHT GEOLOGIST'S HAMMER, COLD CHISEL, KNIFE BLADE, MASKING TAPE, AND PLASTIC SAMPLE BOXES

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value without, and must therefore be supplemented by, the laboratory analysis of rock and paint specimens as they are collected. It will be the responsibility of the prime researcher to ensure that the specific objectives submitted to laboratory specialists are carefully thought out beforehand. A possible result of laboratory research may be to demonstrate the usefulness of experimental simulations of the paintings under controlled conditions; but such experiments would be premature and might prove misleading without prior demonstration of their relevance.

Desk work, besides correlating the findings in field and laboratory, must take two main directions. A style analysis should be undertaken, supplemented by a study of the bark and hide pictography of peripheral regions. A thorough combing of the literature for ethno-historical clues will be equally important, along with a sharp outlook for recent archaeological findings, and for developments in technology that might offer improved methods of recording field information, analyzing field samples, or correlating accumulations of data. Essential to an advance along the whole broad front will be the continuing exchange of information among the dozen or more researchers now investigating one aspect or another of rock art in Canada.

It need not concern us too greatly at this early stage that the variables involved in the weathering of rock art are frustrating complex, the procedures problematical, and the goal itself discouragingly remote. There will be rich, and frequently unexpected results along the way – some useful to investigators in other fields, others providing insights into pictography itself that we cannot now foresee. And the goal itself is alluring. If, out of an understanding of the weathering complex and the bonding process, a method of determining the age of a rock painting or glyph should finally emerge, it might be applied to the thousands of rock paintings around the globe which so far – like the Hickson-Maribelli paintings and the great majority of rock art manifestations throughout the Canadian Shield Woodlands – have baffled every other known approach.

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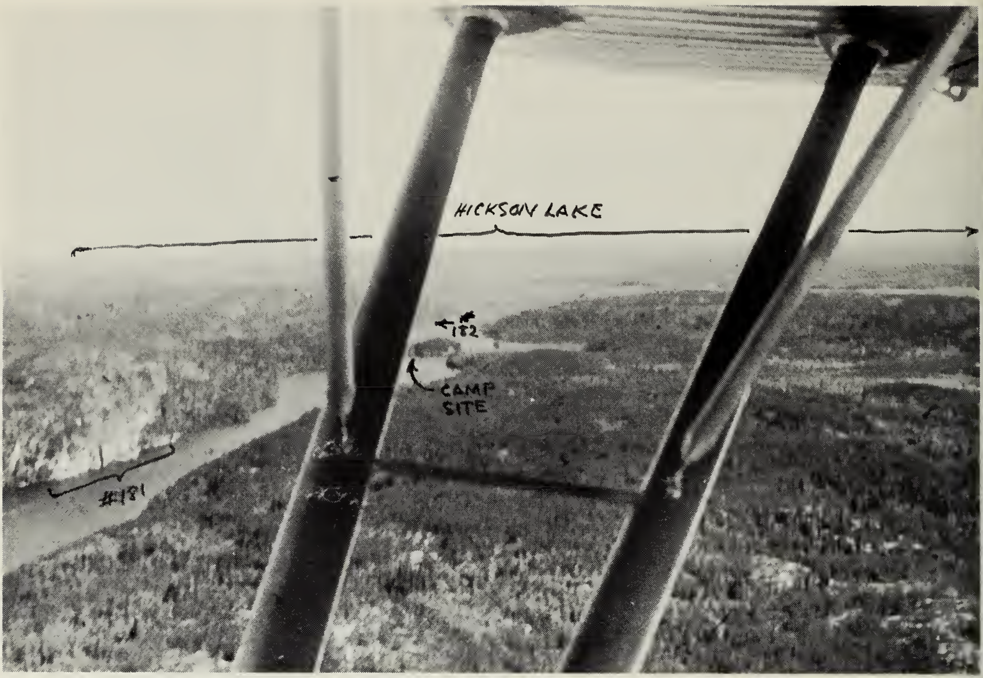


Plate 1 *Air view of the Hickson-Maribelli site.*

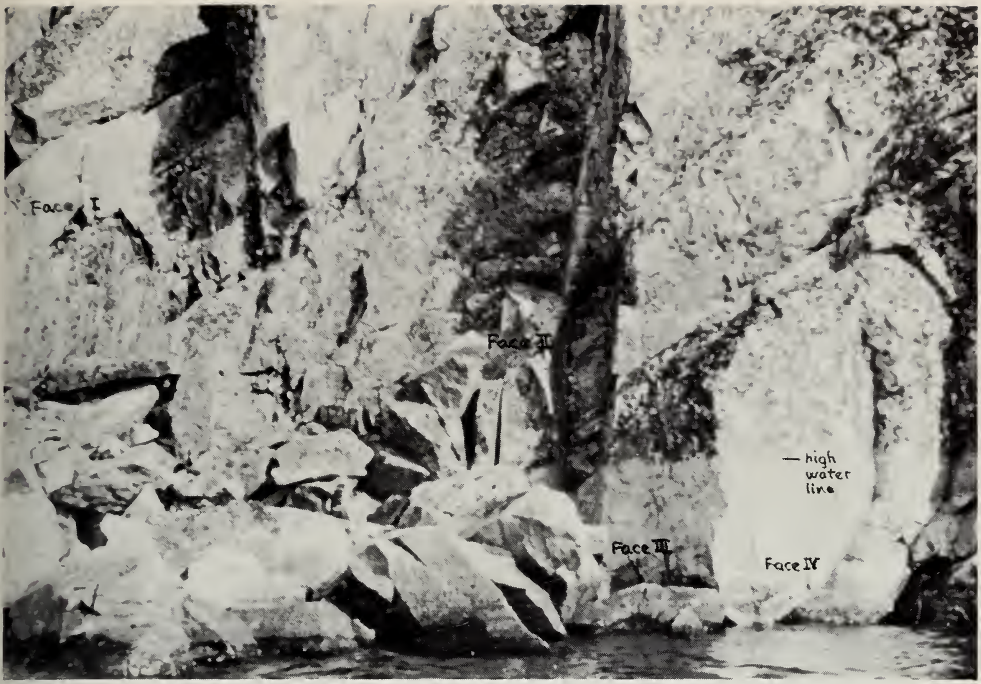


Plate 2 *Faces* I *to* IV, *Site #181.*

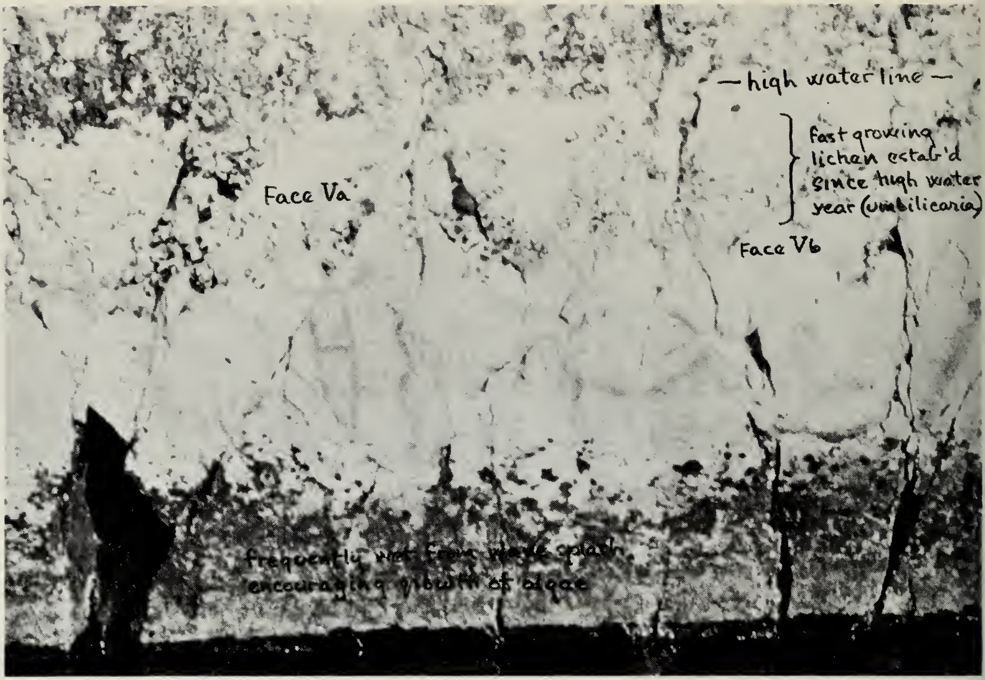

— high water line —
fast growing lichen estab'd since high water year (umbilicaria)
Face Va
Face Vb
frequently wet from wave splash encouraging growth of algae

Plate 3 *High water line on Face* v, *Site #181.*

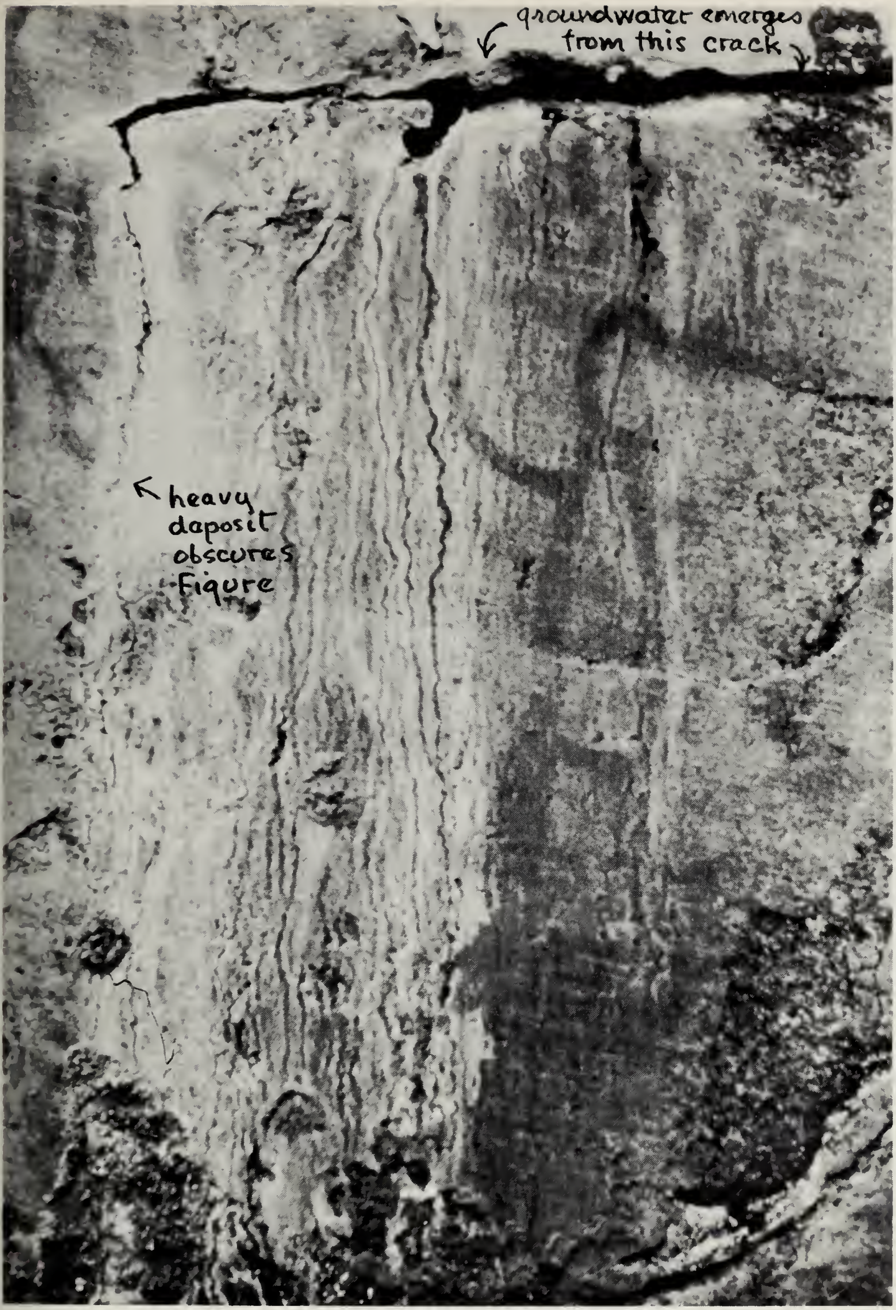

groundwater emerges from this crack
heavy deposit obscures Figure

Plate 4 *Paintings at Frances Lake obscured by mineral deposits.*

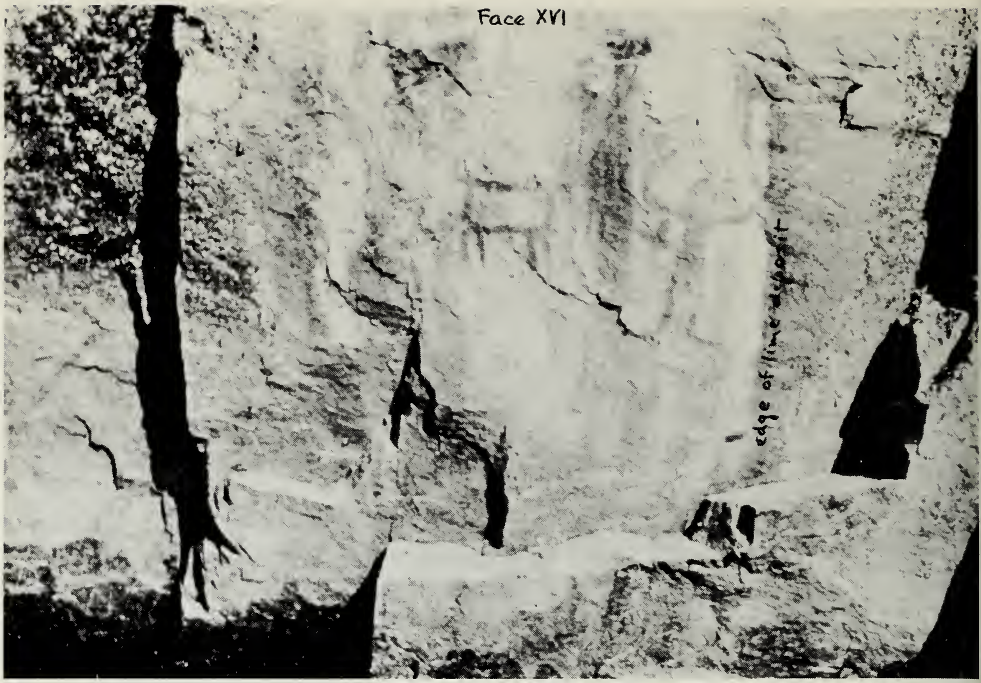


Plate 5 *Paintings on Face* XVI, *Site #181, made over mineral deposits.*

Plate 6 *Mild wave wash at Agawa site.*

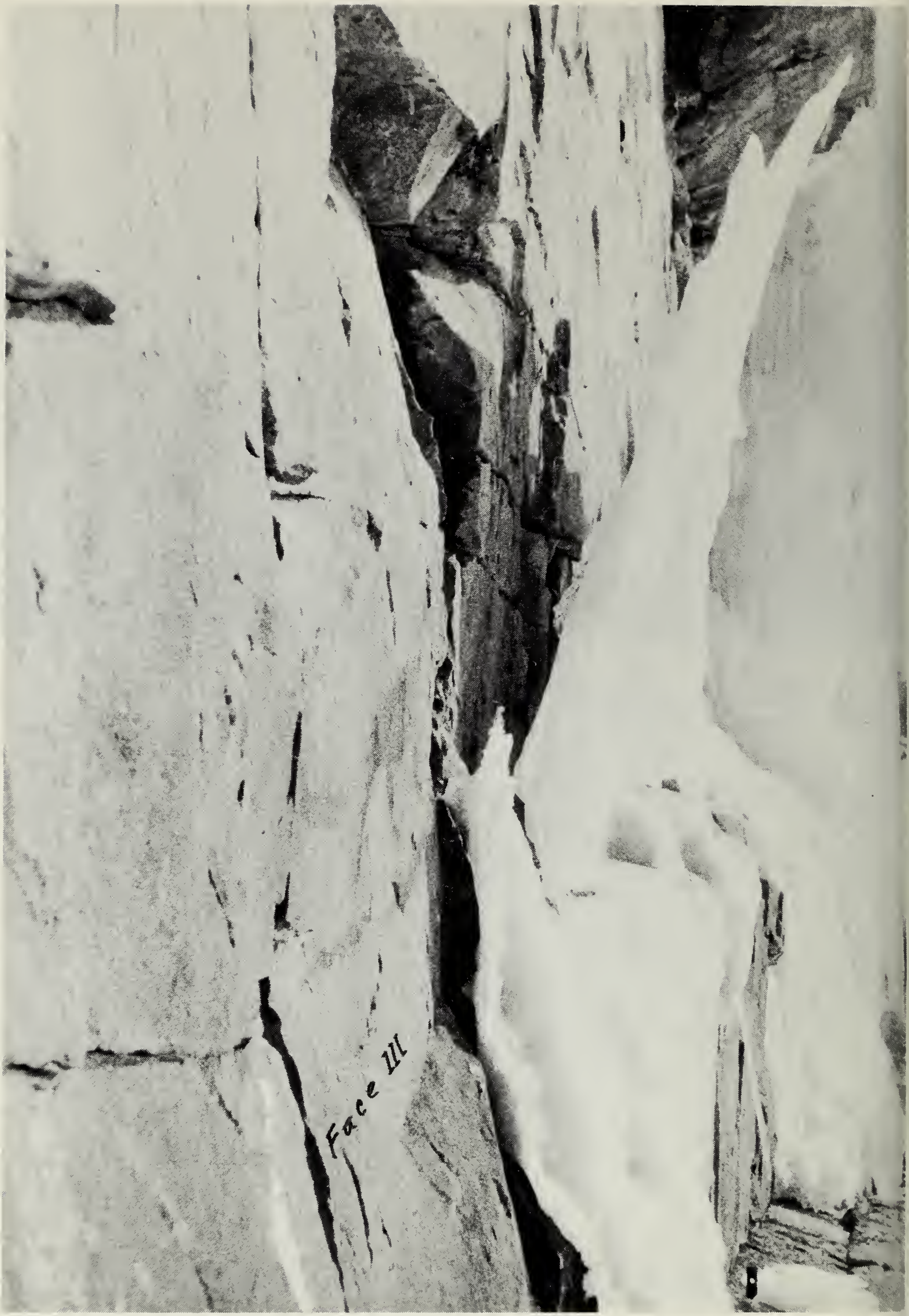


Plate 7 *Frozen wave splash detaching from rock at Agawa. Courtesy Ontario Dept. of Lands and Forests.*

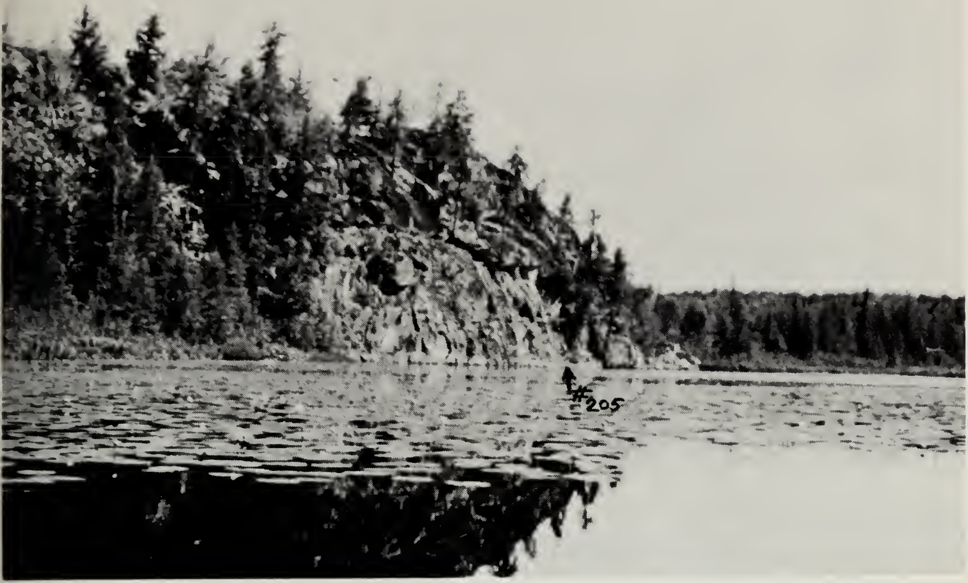


Plate 8 *View of Frances Lake site from due south.*

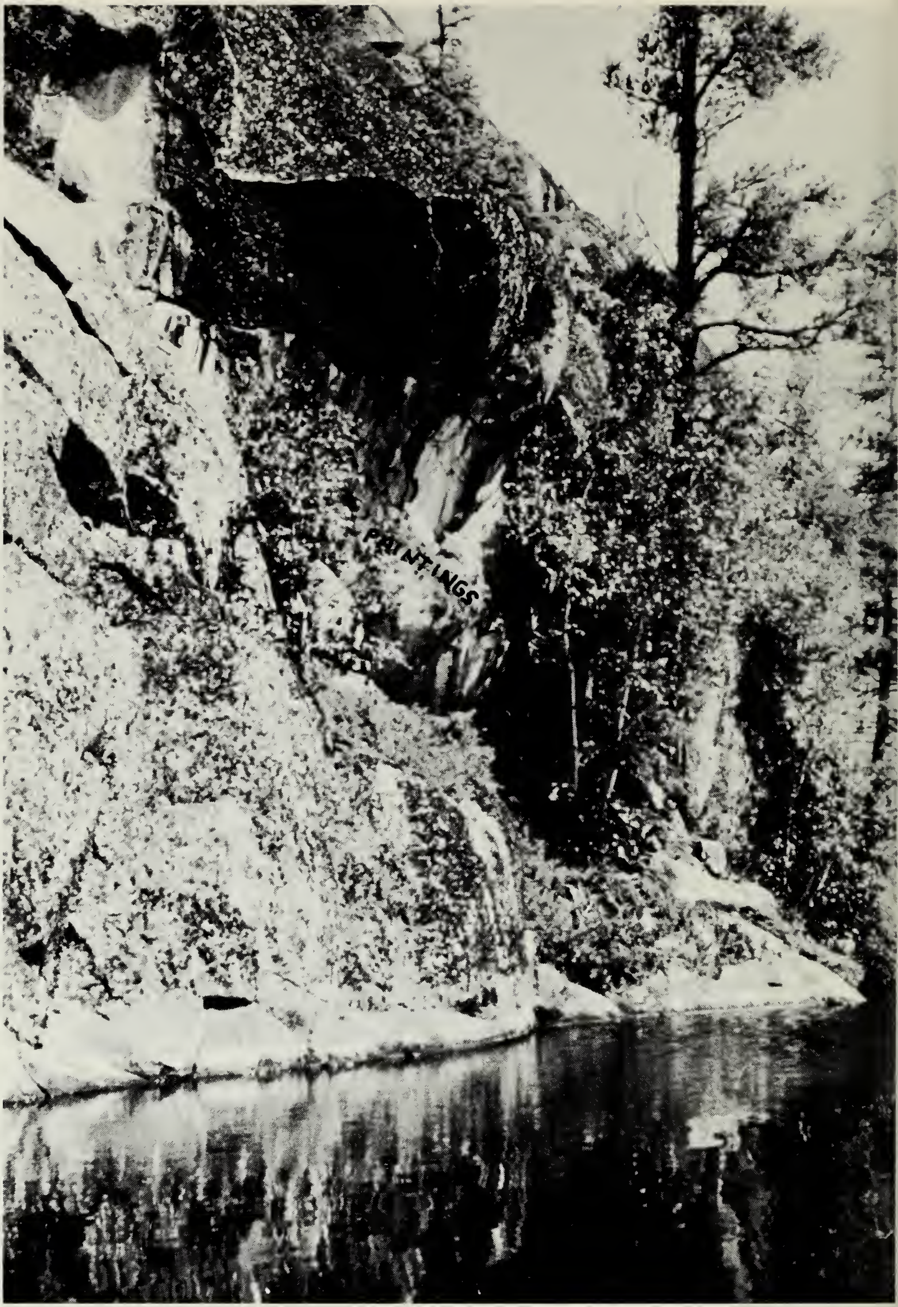


Plate 9 *General view of setting at Frances Lake, from due south.*

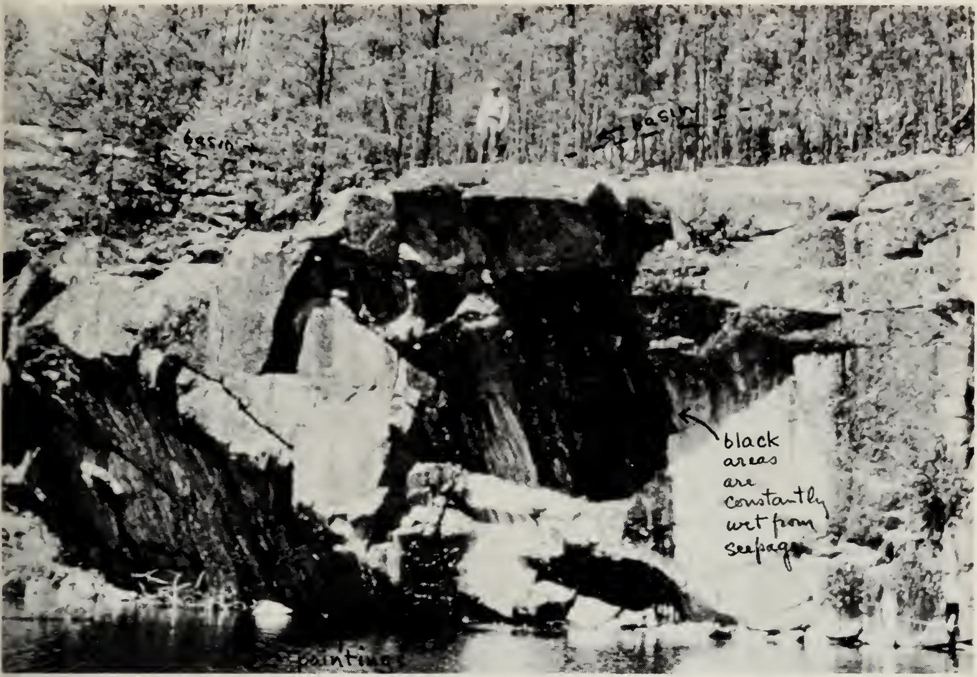


Plate 10 *General view of setting at Fishing Lake.*

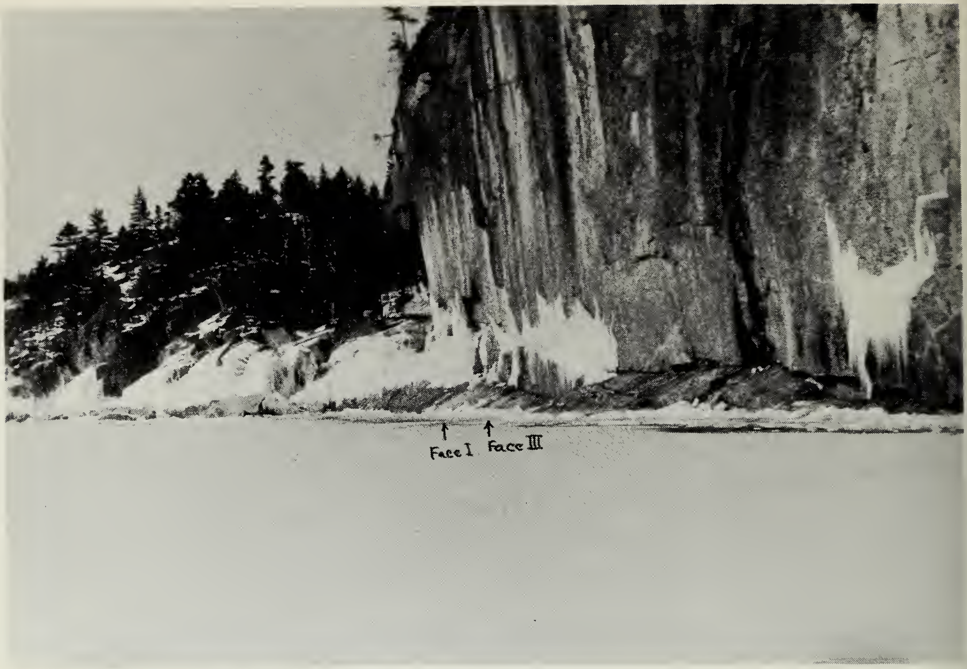
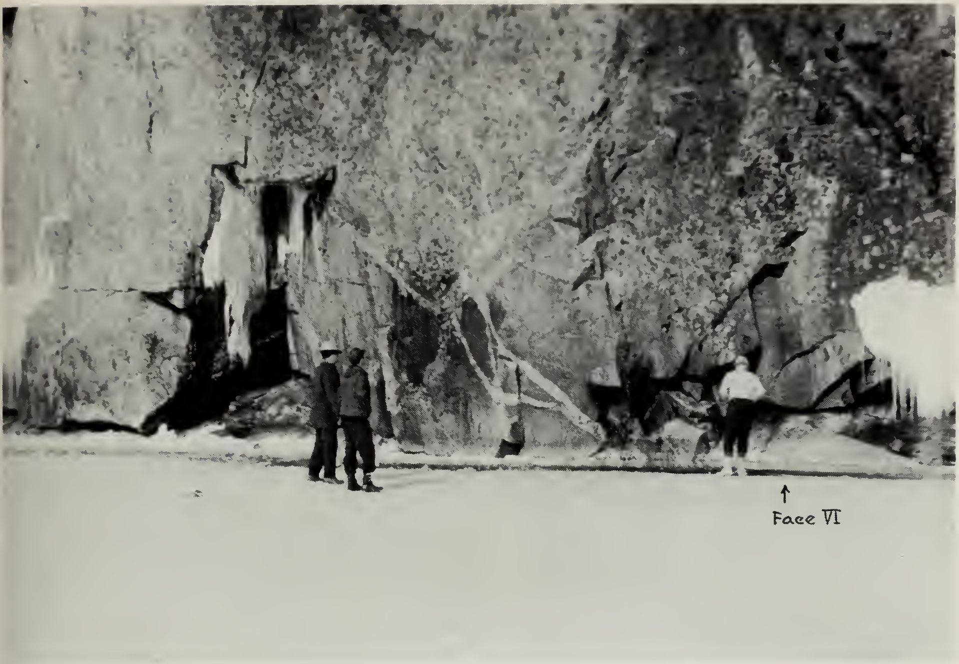


Plate 11 *Panorama of the Agawa site in February, 1969. Courtesy Ontario Dept. of Lands and Forests.*


Face VI

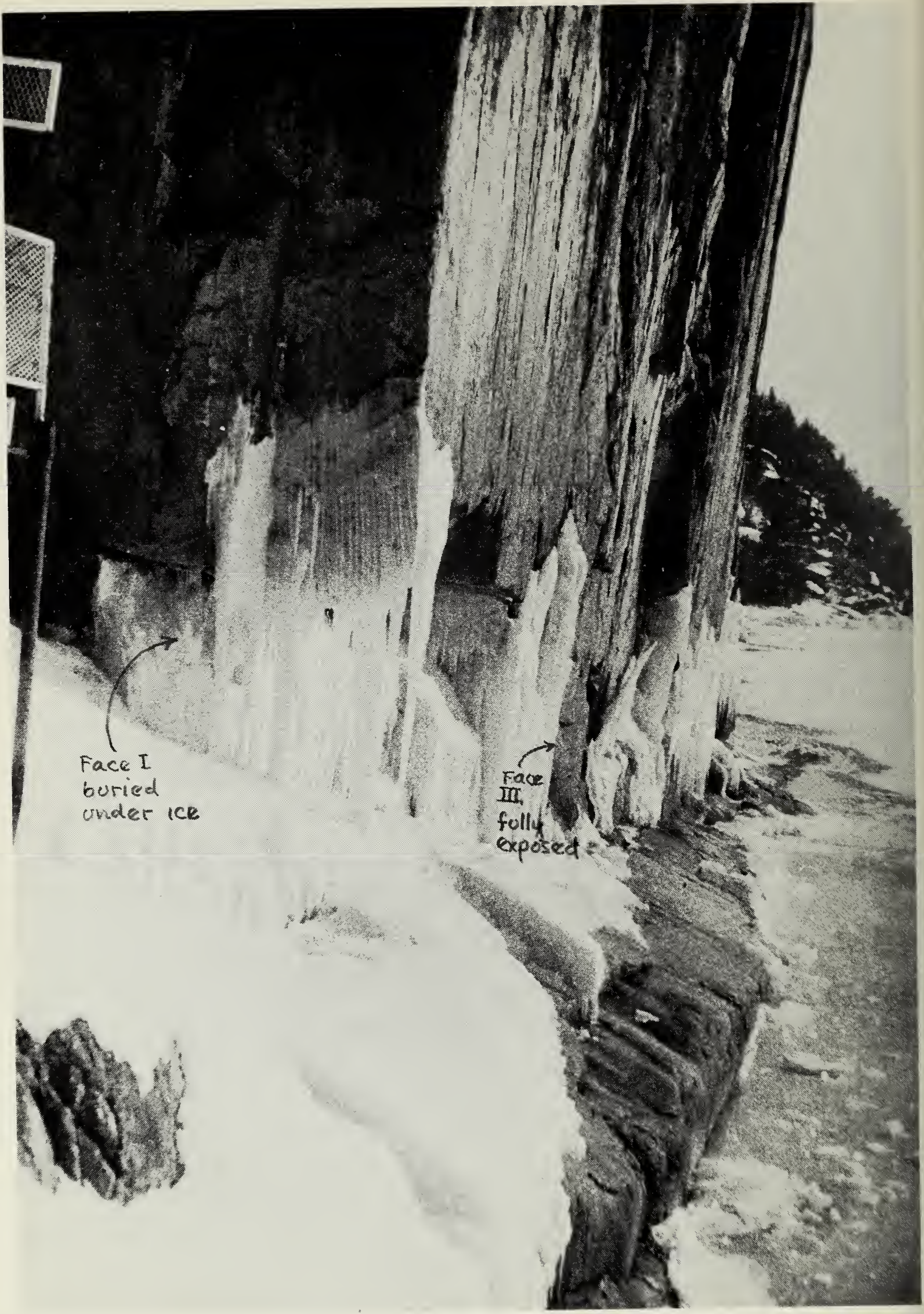


Plate 12 *Frozen wave splash at Agawa, February, 1969. Courtesy Ontario Dept. of Lands and Forests.*

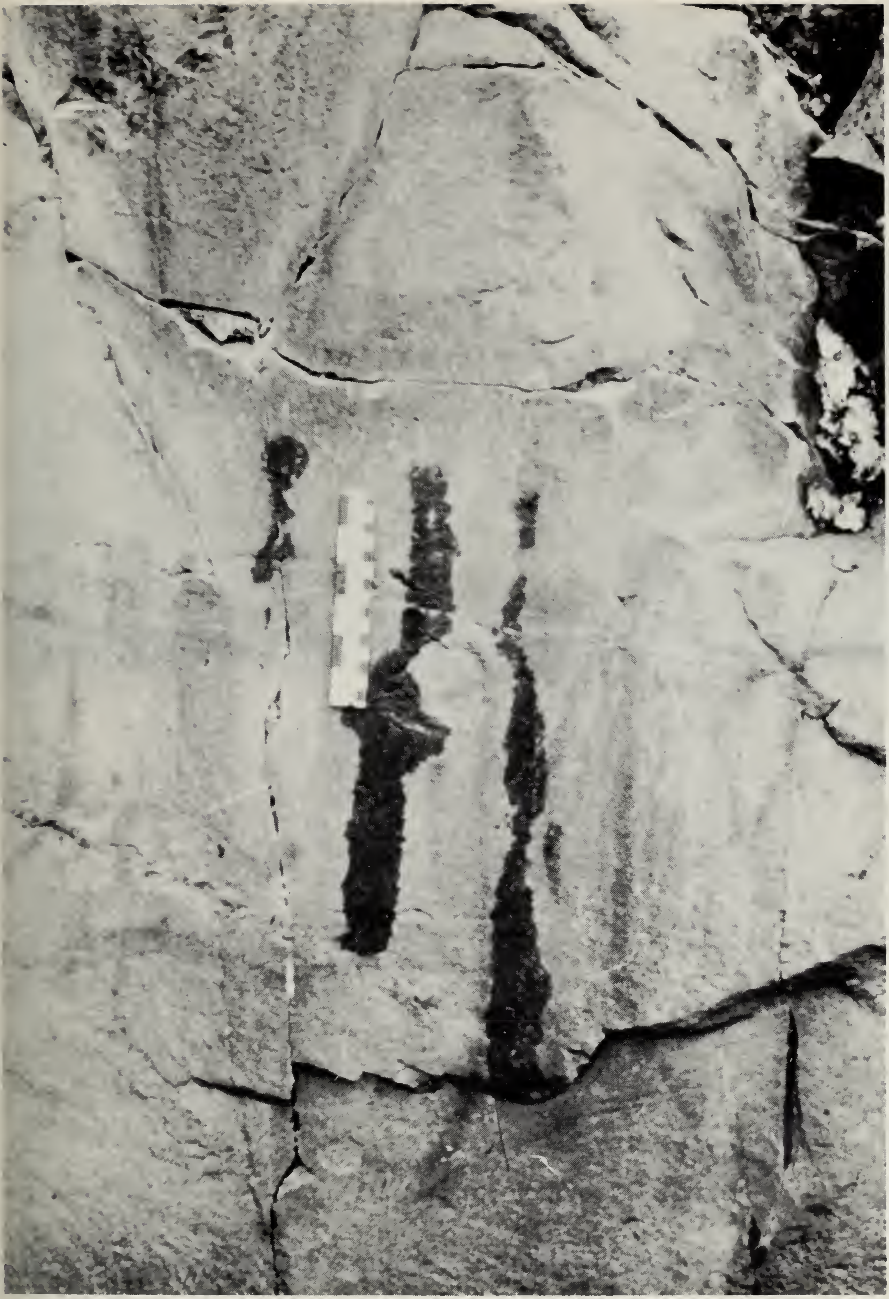


Plate 13 *Splash tests at the Fishing Lake site.*

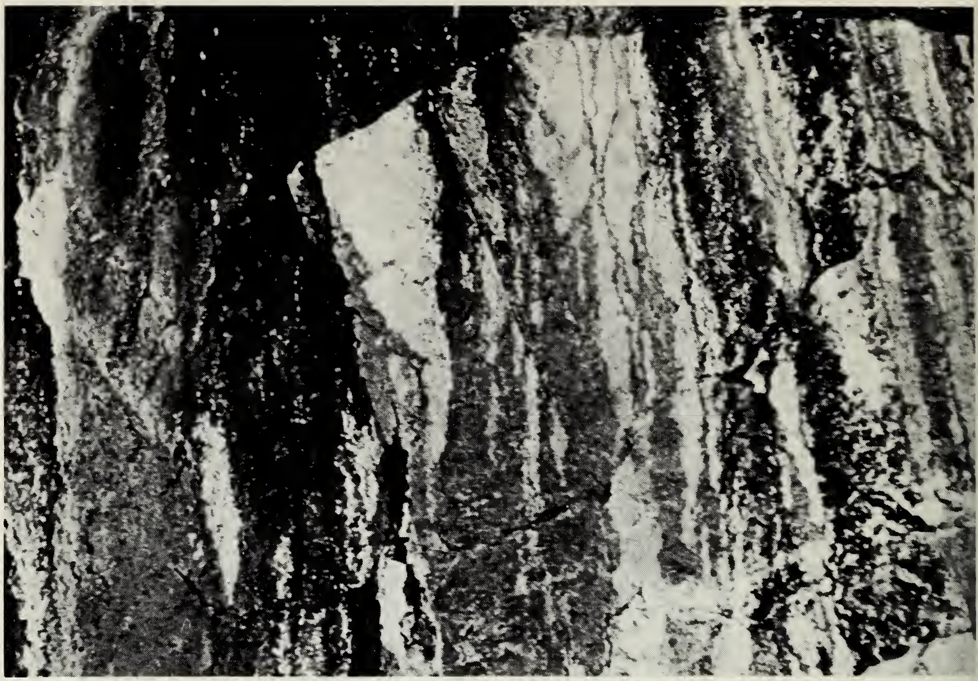


Plate 14 *Groundwater seepage tracks on Face* I, *Agawa, following rain.*

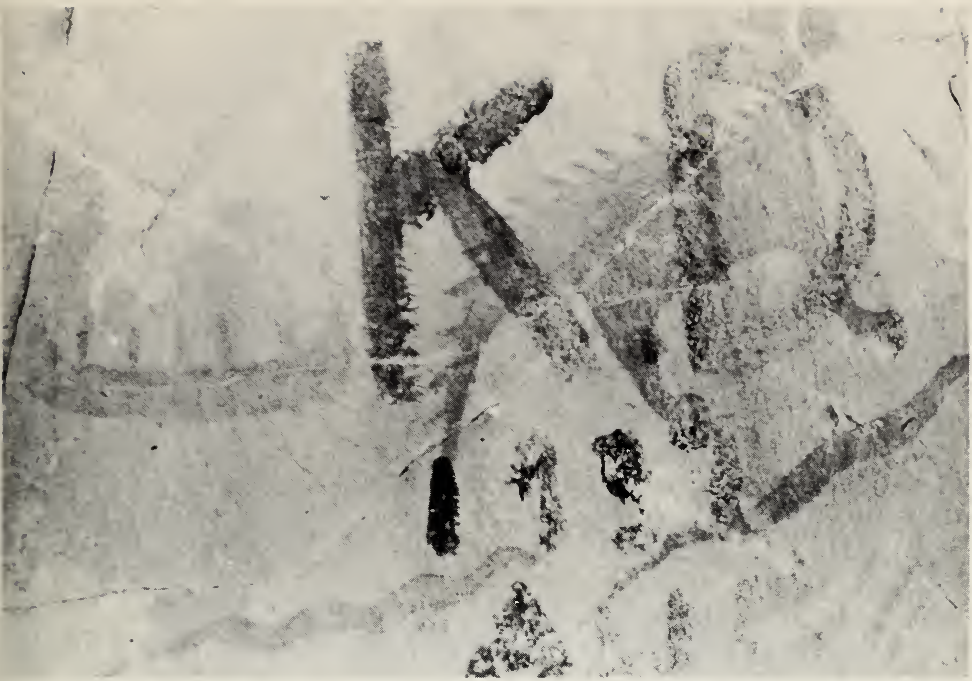


Plate 15 *Early vandalism at Agawa.*

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